METAL INDUSTRY

28 FEBRUARY 1958

Metal Finishing

FIFTY years ago, the only processes included under the heading metal finishing would have been electroplating, hot dip tinning, and hot dip galvanizing. In those early days, and, indeed, until comparatively recent times, the craftsman was paramount; old timers will remember that in many cases only he seemed to be able to make the processes work satisfactorily. With the passage of time, demand has arisen for more varied and more effective finishes for a multitude of purposes so that to-day the metal finishing industry can offer bright plating, alloy plating, hard, and porous, chrome plating, anodizing, organic finishes, vacuum deposition and so on. Thus, in a short space of time, the metal finishing industry has built up an immense industrial structure of tremendous economic importance. In this structure craftsmanship still plays a part, albeit a continually diminishing one, but with the advent of more and more complicated processes, has come a demand for scientifically trained personnel. Unfortunately, metal finishing occupies the same kind of place that metallurgy did until comparatively recent times when sandwiched between the engineer on the one hand, and the chemist on the other, the metallurgist found his scope and status very limited. Now the metal finishing expert finds himself the sandwich between the metallurgist and the chemist.

The result is that facilities for training the metal finishing technologist are few. Admittedly, steps have already been taken by the Metal Finishing Association and the Institute of Metal Finishing to provide the craftsmen, and, in due course, the supervisors for the industry by the inauguration of the apprenticeship scheme, referred to in this column in the issue of November 2, 1956. Incidentally, first reports of the working of the scheme, though by no means startling, are encouraging. Also, at least one university, Nottingham, offers a degree course in metal finishing, with subsequent research facilities, and another, Birmingham, has a research fellowship on the subject. But the fact remains that no training comparable with the recently instituted Dip. Tech. is, as far as we are aware, offered anywhere in the country. Training of this standard, or approaching it, is, according to Dr. J. E. Garside, Principal of the Borough Polytechnic, in a recent talk to the Midland Section of the Metal Finishing Association, logically, the next step that should be taken.

Whether the industry would be capable of providing suitable prospects for large numbers of technically trained men of that calibre, is, we must confess, a debatable point. Whether, indeed, sufficient numbers of candidates would come forward for training is another. Admittedly, there is a need for technologists with training midway between honours degree and craftsman standard. Men, for instance, with a knowledge of industrial relations, and, of costing as well as an understanding of electrochemical and other surface coatings. Such a training, we suggest, could be offered by the technical colleges in full-time or sandwich courses. But for any such scheme to succeed the demand must come from the metal finishing industry itself. The scheme must be backed wholeheartedly by the industry which must be willing to release selected senior staff to attend approved courses, to help in the provision of suitable equipment where necessary and finally be prepared to give financial assistance to any college ready to undertake the training of students of this type. Provided this co-operation is forthcoming, we have no doubt that a number of technical colleges would be prepared to consider the provision of suitable courses. Is the finishing industry willing to act?

Out of the
MELTING POT

In the Limits

ALL the evidence available hitherto seems to suggest that, broadly speaking, size effects vary only slowly with size. So far as large sizes are concerned, as, for instance, the large size of the earth and its effect on the iron-nickel alloy of its core, this fact is likely to remain of academic interest. As the range is extended beyond normal engineering dimensions towards smaller and smaller sizes, the overall change in the size effect becomes more noticeable. While, admittedly, the matter may be complicated by the occurrence of factors that cause discontinuities in this change, the net effect is such that, ultimately, it does bring about some quite remarkable characteristics. Of these, the permanent magnetism of sufficiently small (single-domain) particles of pure iron, and the outstanding strength and elasticity observed in metal and, more recently, in ceramic whiskers, are the best known. It is also in connection with ceramics that reduction in size achieves a change in one of their most characteristic properties, namely brittleness. This change can be demonstrated by taking a cut over the polished surface of a single crystal of sapphire, ruby or polycrystalline pure sintered alumina with a sharp pointed diamond, held at an angle of approximately 45° to the surface and using a slight pressure and a speed of a few cm/sec. Under these conditions there may be formed, in addition to the fine powder of the brittle material, long curling chips, closely resembling those obtained when turning metals, but having a thickness of about 0·5 micron. Such continuous chips obtained from sintered alumina confirm the complete coalescence of the particles on sintering, a few separate free ends or branches on the chip indicating the presence of individual crystallites.

Go On

WHEN using the imagination to visualize the future, it is the time span envisaged that determines the scope of the exercise. The attractiveness of the vision seen is, on the other hand, usually inversely proportional to the time span. Visions restricted to the immediate future carry with them too much of a suggestion that something should be done about them that looks rather like hard work to be really attractive. Take, for example, the imaginative idea of producing metal parts by building up instead of cutting down as in conventional machining. Looking only a short distance ahead, one can visualize "a device which, under electronic control, would put on instead of cut off metal, to form some fancy shape" (this page, METAL INDUSTRY, 24 January 1958, p. 62). A good deal further away, and as yet inaccessible to a practical approach, are the repercussions of thermonuclear fusion—the prospects of unlimited power and of temperatures measured in millions of degrees—on metallurgy: "Will dislocations, and lattice imperfections and mosaics, which limit the present strength of metals, become preventable if controlled condensation of metal vapour replaces the traditional freezing of metals?" (METAL INDUSTRY, 31 January, 1958, p. 83). Still further ahead—in A.D. 2,000, in fact—the writer of a letter to a technical journal discerns the possibility that "metal alloys might be produced atomically through atomically combining the elements required to produce the alloy and arranging the resulting combination directly into the shape desired." In this way, "steps such as smelting, rolling, casting, punching, stamping, and machining could be eliminated. It has been said that what man can imagine, man can do, so who knows?" There is no doubt about the attractiveness of these long-distance visions, nor about that of these closely similar trends of thought when added together. Is it sufficient to get somebody to make a start:—on an electromagnetic system to hold and rotate a "nucleus" in mid-air (or mid-inert gas or vacuum) while one or more sprays of molten vapour, or streams or jets of metal vapour, are directed on it to build it up.

Wider Conditions

TO a chemist accustomed to thinking in terms of both temperature and pressure wherever the equilibrium and/or end products of a reaction between reactants, at least one of which is gaseous, are concerned, the fact that this appears only recently to have been discovered in connection with metallurgical processes comes somewhat as a surprise. This delayed discovery or realization is probably accounted for by the ease with which reduction of many metal oxides, for example by hydrogen, can be effected by heating alone. In those cases, such as the oxides of aluminium, titanium and zirconium, or the oxides of non-metals such as boron or silicon, where reduction by heating in hydrogen did not result in complete reduction and the elimination of impurities such as carbon or nitrogen, the matter seems to have been accepted as such, and other methods, e.g. reduction of the chlorides with magnesium, have been adopted instead. Adopting the broader "chemical" approach, it has now been found that complete reduction as well as elimination of impurities such as carbon and nitrogen can be achieved in these cases by heating in hydrogen under pressures ranging from 100 to over 1,000 atmospheres. It is thought that such pressures cause a widening of the lattice spacing of the metal structure, facilitating penetration of the hydrogen, reduction of the oxides and elimination of impurities. The hydrogen is preferably recirculated, with the elimination from it in the process, by suitable means, of reaction products and impurities. As an example of what can be achieved, titanium dioxide can be reduced with hydrogen at 1,000 atmospheres and at 1,000°C. to a metal containing less than 0·1 per cent oxygen or nitrogen. Vanadium metal containing less than 0·05 per cent impurities can similarly be obtained at 2,500 atmospheres and 800°C. The increase in the lattice spacing of metals occurring on heating in hydrogen under pressure, can furthermore be used by combining the reduction of oxides with the formation of carbides, borides, silicides, etc., e.g. of chromium, titanium or tungsten. The use of hydrogen under pressure also has advantages in those cases in which reduction of a metal will proceed by simple heating in hydrogen at normal pressure. If the hydrogen is used under pressure, however, it becomes possible to carry out the reduction at lower temperatures and obtain in this way a much finer powder with desirable surface characteristics which make for easier sintering and improved sintered products. For example, tungsten powder having a particle size less than 0·1 micron can be obtained from tungstic acid by reducing the latter with hydrogen under high pressure at a temperature which may be as low as 450°C.

Skinner

REVIEW OF PROGRESS IN ARC, INDUCTION AND RESISTOR FURNACES

Electric Furnace Developments

By P. F. HANCOCK, B.A., F.I.M.

Wider usage of electric heating for melting furnaces, industrial ovens and brazing plant has followed the increased attention given to the design of such equipment for applications which hitherto relied upon heat from other forms of fuel. This Paper, given recently before the Birmingham Metallurgical Society, and published here in shortened form, describes some of the progress made in this field, and a number of recent applications.

THE introduction of electric furnaces as an industrial tool began some fifty years ago. The type first put to commercial use on any scale was the arc melting furnace, the earliest example of which dates from the first decade of this century. Resistor furnaces for heat-treatment operations came a little later and received some impetus to development during the First World War. Induction furnaces of both channel type and coreless type followed in the 1920s.

However, the major development has taken place during the last 25-30 years, during which time the total connected load of electric furnaces in this country has grown from a negligible amount at the beginning of the period to something in the region of 1,500,000 kW at the present day. Of this latter total, about three-quarters may be accounted for by heat-treatment furnaces and the remainder by melting equipment.

The early acceptance of electric furnaces in certain fields was associated with two technical features, which are common to all types. First, the source of heat is independent of any combustion process, so that the furnace atmosphere may be made oxidizing, neutral or reducing at will, and there is no contamination of melt or charge by unwanted combustion products. Secondly, the heat input and the temperature can be controlled with a high degree of accuracy and reproducibility. In addition, with certain types, higher temperatures may be reached than are possible or convenient with fuel-fired equipment. On the other hand, the cost of electric power at the time in question compared unfavourably in terms of pence per B.Th.U. with alternative fuels, except in those countries or localities where hydroelectric power was available. This higher fuel cost was only partly balanced by the greater efficiency of electric furnaces.

Thus, the classical applications of electric furnaces generally were to the manufacture or treatment of high quality products, where fuel costs were not the prime consideration, but where one or more of the technical features referred to above were of overriding importance.

In recent years, however, the economic trend has been such as to narrow the price gap between electric power and other fuels. For example, power to-day costs on average no more than 1·2d/kWh, against 0·5d.-0·6d. in 1939, whereas coal and fuels derived from it have more than trebled in cost in the same period. This, in turn, has opened the way for electric heating to compete on purely economic grounds in the production of common quality materials.

To illustrate this point, let us consider the cheapest metallurgical product, namely, ordinary cast iron, which at present is almost universally melted in the cupola. A recent analysis has shown that when the cost of power is such that 3,670 kWh can be obtained for the price of one ton of foundry coke, electric melting will be cheaper in fuel costs than the cupola. At present prices in this country (1·2d/kWh × 3,670 = £18 7s. 0d., 1 ton foundry coke = £10-£11), this point has not yet been reached, but it may well be approached in a few years' time.

As far as can be discerned, future trends seem likely to accentuate this situation. At present, the cost of combustion fuels continues to rise at a more rapid rate than electric power from conventional sources. If, as a result of the advent of nuclear power on a large scale in ten to twenty years' time, power costs should show a marked decrease, as has recently been predicted, then the use of electric heating in metallurgical processes may well become mandatory rather than merely alternative (at any rate in this country).

The economic factors relating to the past development and present utilization of electric furnaces have been discussed in this way, since they clearly have had, and will have, a major influence on their application. However, this should in no way be allowed to minimize the technical developments in both design and application which have simultaneously been taking place, and which are also contributing to their increased use.

Against this background, it is intended to look at various categories of electric furnaces and to see along what lines development is taking place.

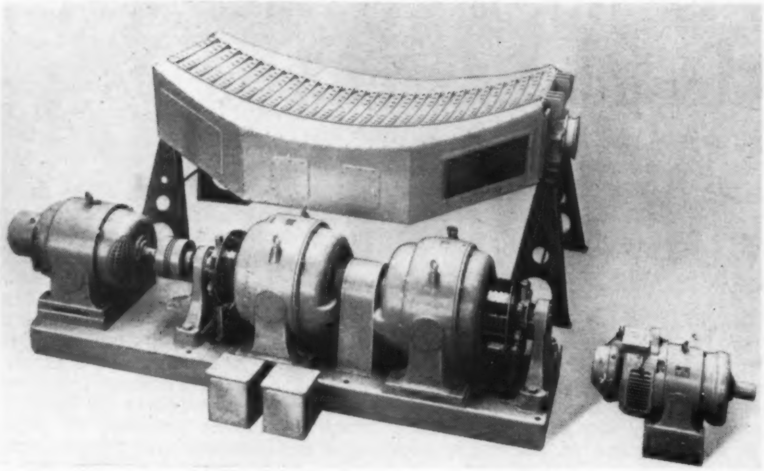
Direct Arc Furnaces

Among electric melting furnaces, the most important type, from whatever aspect viewed, is the three-phase direct arc furnace, as employed for steel making. As already mentioned, it was originally developed by Héroult in the 1900s, and found its first use as a replacement for crucible furnaces in the production of tool steels. Later, its use was gradually extended to the making of all types of alloy steel, stimulated in the first place by the demand for such steels for armaments during the First World War. Later, it came also to be accepted as a desirable alternative to the Tropenas converter or the open-hearth furnace for foundry purposes. These remained its principal applications during the inter-war years. It was not at this time seriously considered as a competitor to the basic open hearth for the making of common quality steel ingots on a tonnage basis.

During this period, also, the basic design became stabilized as a three-phase unit, with three vertical symmetrically-placed electrodes depending through the roof, fed from a heavy-duty transformer with multiple voltage taps and incorporating sufficient reactance to prevent excessive current surges. A removable roof, operated by a hydraulic lift and swing-aside mechanism or a travelling gantry, to permit quick charging and facilitate lining repairs, and some form of automatic electrode control also became standard features. The largest units were generally of the order of 20-25 tons capacity.

In more recent years, during and since the Second World War, there has been no fundamental change in design, although many detailed improvements aimed at better control and increased output have been made. Such features include more sensitive methods of electrode control, on-load tap changing, higher power ratings and additional water-cooling of vulnerable parts of the furnace body.

The increase in size of arc furnaces has introduced no special construction difficulties, and up to the largest size so far built (24 ft. 6 in. shell), the basic design remains essentially the same as for the well-known smaller units. It may well be asked whether the upper limit has been reached or is being approached. The answer probably lies in the electrical engineering aspects of such furnaces rather than the mechanical construction or operational features. Broadly speaking, no advantage is obtained by increased holding capacity, unless it is accompanied by a corresponding increase in power; the problems of introducing power much in excess of the 35,000-40,000 kVA at present used with the largest existing furnaces are formidable. With present knowledge and designs, the only solution is by increasing voltage to a level (greater than 600 V) which would appear unacceptable from various



Above: Fig. 1—Induction stirrer as used on 60 ton furnace

Right: Fig. 2—Coil assembly of mains frequency coreless induction melting furnace

aspects, including the safety of operating personnel.

One operating difficulty does arise with large furnaces, which has led to an interesting ancillary development. In electric furnace practice, the initially-formed oxidizing slag must be removed at a certain stage, whether preparatory to pouring, in the case of a furnace working single slag for common steels, or before building up the refining slag in the case of two-slag operation for high-grade steels. The slagging-off is done by manual rabbling through the back door. On large furnaces, this operation becomes very exacting for the crew, and some mechanical aid is almost essential.

The problem has been solved by the use of an electro-magnetic stirring device, which produces gentle circulating currents in the molten bath, of direction such as to float the slag towards the slagging door. The type at present in use employs a very low frequency alternating field, usually ½ cycle/sec., produced by a system of coils and pole pieces located beneath the furnace bottom (which must be of non-magnetic, i.e. stainless, steel). The coils are fed from a suitable generator and the principle is similar to that of an induction motor.

The whole assembly is somewhat complex and costly, and it is to be hoped that a simpler and cheaper version may be developed in due course. However, even in its present form it is justified on large furnaces. The coil assembly for a 60-ton furnace is illustrated in Fig. 1.

When operating the two-slag process for alloy steels, the stirrer is also advantageous in the refining stage for increasing contact between the slag and metal, and so shortening the required time for completion of the reactions.

Induction Melting Furnaces

There are two well-known types of induction melting furnace, both established since some 30 years ago. The first is the channel type, or core type, operated always at mains frequency (50 or 60 cycles/sec.), of which the Ajax-Wyatt is the best-known variation. In these furnaces, a loop or channel of V, U, or rectangular pattern extends from the bottom or side of the main chamber, and is threaded by an iron core and primary coil. The loop thus forms the short-circuited secondary of a transformer, and must, of course, be kept filled with molten metal for the furnace to be operable.

The applications and limitations of the channel-type furnace are too well known to need elaboration, and there has been little basic development in recent years. The main limitation to extended use is the problem of refractory life in the melting loop, where the temperature is higher and erosion due to metal turbulence greater than in the main bath. Considerable research is in progress to find improved refractories for some of the standard uses in the non-ferrous field, e.g. the melting of pure copper, cupro-nickels and aluminium alloys. In the ferrous field, application is limited, by the same considerations, to the lightest duty, such as holding or superheating of cast iron. Radical improvement in available refractories is needed before the furnace can be seriously considered for more arduous duty, such as the melting of steel.

The second principal type of induction melter is the coreless furnace, in which the chamber, in the shape of a cylindrical crucible, is surrounded by a helical primary coil. This furnace, first developed by Dr. Northrup in 1925-30, has until recently always been operated at elevated frequencies, of upwards of 500 cycles/sec., and, in fact, has often been called the "high frequency" furnace. It is an excellent furnace for straight melting operations, i.e. where no slag refining operations are required, and is regarded as the ideal unit for high quality materials for which contamination must be kept to a minimum. Commonly-used sizes range from a few lb. in capacity up to about one ton, though a few larger units have been built. The main obstacle to wider use has been the high capital cost, resulting from the need for an expensive motor-generator set and associated electrical equipment for frequency conversion.

That the coreless induction furnace could be operated at mains frequency has been recognized since the early days of its introduction. But certain difficulties or disadvantages, with regard to both construction and operation were thought to make it impracticable. However, in the event, these difficulties have proved surmountable and, following intensive development over the last eight years, particularly in Germany, the mains frequency furnace has become firmly established. Something over two hundred installations are operating or under construction, of which more than thirty are in this country. Capacities range from 15 cwt. to 20 tons, and power ratings from 150-1,500 kW. Higher powers up to 2,250 kW are available for capacities upwards of 8 tons.

Elimination of the costly frequency-changer results in the capital cost of a mains frequency installation being only one-half to two-thirds of that of a high-frequency furnace of equivalent capacity and power rating. This is in spite of the heavier and more expensive capacitor bank required for power factor correction at 50 cycles/sec., as compared with high frequencies.

The expected difficulties with the mains frequency coreless furnace, referred to above, were threefold. First,

due to the inverse relation between field penetration depth and frequency, there is a lower practicable limit for furnace chamber diameter, which limits the minimum capacity to about 15 cwt. (iron). At smaller sizes, the efficiency becomes unacceptably low, and there is difficulty in getting adequate power into the charge before it is fully molten. In practice, even with sizes of 15 cwt. and upwards, it is desirable to start from cold with a solid plug forming part of the charge. For subsequent heats, a heel of molten metal may be left in the furnace.

Secondly, since the number of ampere-turns in the furnace coil required for transmission of a given power to the charge increases as the frequency is lowered, the electromagnetic stirring effects in the melt also increase, and, it was thought, would result in an unacceptable degree of turbulence in the melt. This difficulty can be minimized by correct choice of coil dimensions and positioning of the coil relative to the charge, but it remains a real one, setting an upper limit to the power rating for a given size of furnace. Provided this limit is not exceeded, however, the powerful stirring effect can be put to good use in certain applications, as will be referred to later, and in others is not objectionable, as might be expected. There is also little adverse effect on lining life.

The third difficulty is one of construction. Due to the high coil current, there are strong vibrational forces set up in the coil itself, and extremely rigid construction is necessary to ensure satisfactory operation (Fig. 2). The coil is tight-wound of special section heavy copper tubing, and is clamped endwise in a framework of which longitudinal lamination packs form part. These packs also confine the electrical field and permit a rigid steel case construction without unwanted stray heating effects.

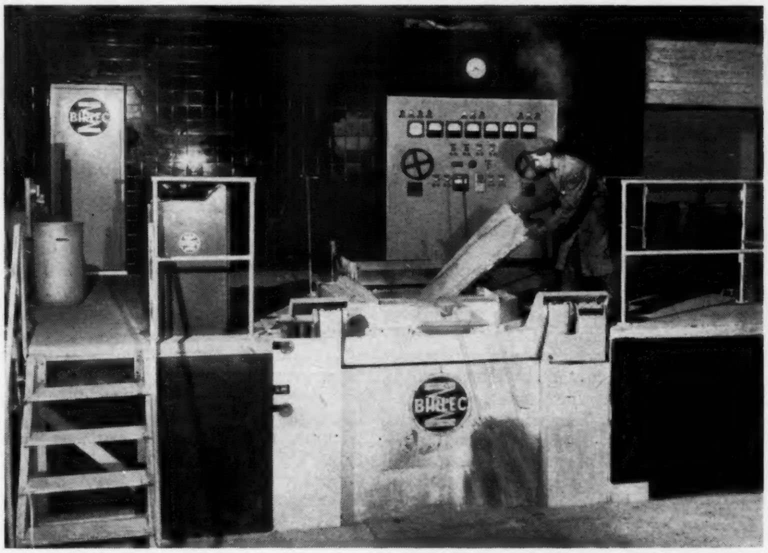
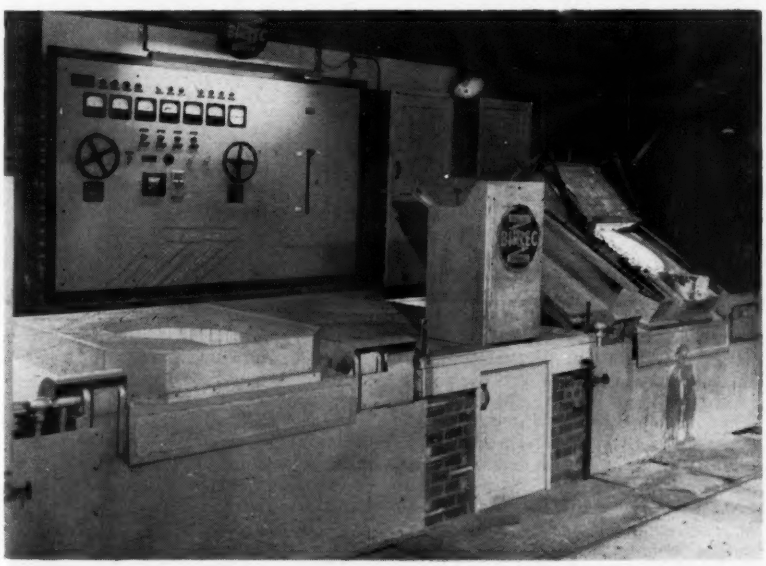


Fig. 4—Mains frequency coreless induction melting furnace, 200 kW 12 cwt. capacity for aluminium alloys

So far, the M.F. coreless furnace has found its largest application in the melting of cast iron, particularly the reclamation of borings, for which purpose the powerful stirring is of considerable advantage, ensuring quick melting with minimum oxidation. Advantage is also shown in the manufacture of synthetic irons of high purity from steel scrap, recarburization of the melt being effected with extreme rapidity and efficiency up to any carbon level required in normal practice. This technique is of especial value in the production of S.G. irons. Refining operations are also practicable, e.g. desulphurization may be effected by the addition of powdered calcium carbide to the surface of the melt. The possibility of phosphorus removal by somewhat similar methods, using lime and iron oxide additions, is also being investigated, with promising results.

Fig. 3—Two mains frequency coreless induction melting furnaces for copper-base alloys, each 320 kW 1¼ ton capacity



The reclamation of scrap, particularly turnings, borings and other finely divided material is also being practised in the copper-base and light alloy fields. Shown in Figs. 3 and 4 are a 320 kW 1½-ton furnace for gunmetal, cupro-nickel and other copper alloys, and a 200 kW 12-cwt. furnace for aluminium alloys. A special furnace, of large capacity up to 20 tons, has been evolved to meet the requirements of casting ships' propellers; the first example of this furnace will be commissioned shortly.

The unusual success of the M.F. furnace in such a short period since its introduction, and in so many diverse fields, seems to indicate that it fills a real need and represents a development of the first importance in electric furnace practice.

(To be concluded)

Obituary

Mr. C. Williams

WE regret to record the death of Mr. Charles Williams, chairman of Clevedon Rivets and Tools Ltd., Sutton Coldfield, a subsidiary of Samuel Smith and Sons Ltd., of Smethwick. Mr. Williams joined the latter firm in 1941 as secretary, and was later appointed chairman and managing director. He became chairman of Clevedon Rivets and Tools at the time it was taken over by the Smethwick firm. Mr. Williams was at one time a member of the executive council of the British Ironfounders' Association.

Research Progress

Protective Anodes for Ships

BY RECORDER

THE electrochemical theory of corrosion, used with great success to explain many corrosion phenomena, has been developed over the years from ideas probably first put forward by Arrhenius at the beginning of the century. It has been supported by considerable experimental evidence, notably that obtained by Evans and his colleagues at Cambridge over the last 20-30 years. The theory has been most useful, not only in showing how several kinds of corrosion attack take place but also why certain protective measures work in practice. These two aspects have also been combined, enabling predictions to be made of the best way to overcome particular corrosion problems.

Protection against corrosion often takes the form of a coating applied to the surfaces of the structure or plant to be preserved. The coating may act merely as a physical barrier, preventing the corrosive media from coming into contact with the material of which the basic structure is made. Frequently, however, the electrochemical relationships between the coating, the structural material and the corrosive agents must be such that if the coating is damaged, attack proceeds preferentially on the remainder of the coat rather than being concentrated on the structural material exposed. When this function of the coating is examined further it can be concluded that, in favourable cases, the protecting material need not of necessity cover the whole of the structure and may, indeed, be separate from it, provided electrical contact is maintained. The protecting substance in such circumstances behaves anodically towards the structure, and the method of using "consumable anodes" of a relatively cheap material to prevent attack on a valuable structure has been employed in important instances in practice.

Zinc Anodes

The corrosion of ships' hulls is clearly a serious problem, a solution to which could give enormous financial savings. The use of consumable zinc anodes for this purpose has been suggested and the method has been applied quite widely, particularly in the United States. It has been found, however, that the useful life of such anodes is seriously curtailed by the formation of adherent corrosion products that mask off parts of the anode surface. Sometimes this process is also accompanied by accelerated attack on areas free from corrosion products leading to partial disintegration of the anode. A further decrease in efficiency may also be caused by the presence in the zinc of small quantities of iron (of the order of 0·001 per cent or more) which necessitates the use of very high purity zinc for the application.

Size Factor

Several of these difficulties have been overcome in work carried out for the American Smelting and Refining Company by E. C. Reichard and T. J. Lennox.[1] Their first discovery appears to have been that the performance of commercial-size anodes (in this case 6 in × 12 in × 1¼ in.) could not be predicted from measurements of the behaviour of smaller specimens even when the latter were nearly half the size of the commercial product. The comparison was made by testing the anodes under marine conditions in contact with a steel bulkhead. The total current output from the specimens for a definite immersion period was calculated from the weight loss of the sample, the anode current efficiency being taken to be 90 per cent in all cases. By this means a value of the output can be obtained in amp-hr. units that gives a good indication of the relative effectiveness of the different specimens. "Half-size" anodes containing various amounts of iron, ranging from 0·0002 to about 0·009 per cent gave results showing a gradual decrease in effectiveness as the iron content increased. Commercial-size samples, however, of similar compositions indicated that a very rapid fall in effectiveness occurred as the iron content was increased in the range 0·0002 to 0·004 per cent. These results were compared with those obtained from tests on operating ships. It was clearly not possible to carry out as detailed a programme here, but the limited number of results do show that iron is quite detrimental, and that the total current output may be halved by an increase in iron content from 0·0002 per cent to about 0·003 per cent.

Influence of Iron

The adverse influence of iron is presumably to be attributed to an increase in adherence of the corrosion products formed on anodes containing this element, since some of the results presented by Reichard and Lennox indicate that the initial current density obtained at the start of tests on anodes is independent of the iron content. The disadvantage conferred by the presence of iron could, therefore, be eliminated if an alloying addition could be found which rendered the corrosion products non-adherent, and this appears to have been the principle on which Reichard and Lennox worked. Unfortunately, no details are given of their plan of action—only the successful outcome is reported—and it seems quite probable that this success was achieved fortuitously.

Aluminium Additions

Reichard and Lennox found that combined additions of aluminium (of the order of 0·1 per cent) plus cadmium (of the order of 0·05 per cent) almost completely counteract the effects of iron when this element is present in amounts of up to 0·004 per cent or so. The efficacy of aluminium plus cadmium additions was demonstrated in two types of test. In the first, carried out at a marine test station, the current between the anodes and the steelwork to which they were attached was measured at regular intervals. In this way it was shown that, taking a material containing 0·0002 per cent iron and 0·1 per cent aluminium plus 0·05 per cent cadmium as a control, additions of up to 0·004 per cent or so of iron gave the same or even slightly higher currents for immersion times up to 12 months. Similar tests on anodes containing 0·1 or 1·0 per cent aluminium showed that these single additions did not have the required effect, the presence of about 0·004 per cent iron causing an appreciable drop in current after immersions of six months or less. Additions of cadmium alone were also ineffective.

In the second type of test, anodes were attached to ships operating mainly in coastal waters and the effectiveness measured, as mentioned earlier, by the weight loss of the specimens. Although these trials confirmed the value of the combined aluminium and cadmium additions, they also showed that additions of 0·1 or 1·0 per cent aluminium, or of 0·05 per cent cadmium, also increased the effectiveness of anodes containing small quantities of iron, in contrast with the previous tests, which indicated that the single additions were not particularly beneficial. The authors attribute this difference to a velocity effect present on the moving ships but not at the marine test station.

Examination of the various anodes after test confirmed that the deleterious effects of iron and the advantages conferred by the aluminium plus cadmium additions were connected with the way in which attack on the anodes proceeded. The low-iron anodes or those containing aluminium plus cadmium were attacked evenly, without excessive pitting or the formation of adherent corrosion products.

It is to be regretted that Reichard

(*Continued on page* 176)

Pressure Die-Casting Review

Design of Die-Castings

VI—Some Structural Features of Die-cast Parts

By H. K. BARTON

MORE, perhaps, than any other industrial technique, the die-casting process is tolerant of poor design. Drawn sheet-metal parts wrinkle or tear, forgings fail to fill out the impression, and capstan products burn up the cutting tools if the fundamental limitations peculiar to the process be ignored, but it is possible to ignore virtually every principle of good design in a die-cast component and yet obtain a usable product. It is difficult to say whether this is, on balance, an advantage or a disability. On the credit side, one may count the fact that the lack of absolute limitations renders it possible for die-castings to replace, with little or no change in external form, products previously manufactured by a variety of different processes. On the debit side is certainly the widespread opinion, fostered by this very versatility, that there are, in fact, no actual design limitations and that when die-casters suggest design changes they do so out of sheer perversity.

The truth is that, whereas nearly all die-casting designs are—after a fashion—castable, some are very much more castable than others. In so far as the detailed form of almost every component is to some extent determined by functional requirements, it is to be expected that these latter will, quite often, demand features that depart in some way from the ideal requirements of the die-casting process itself. This cannot be avoided—though the effect can be minimized—but there is every reason why the general form of the component, to the extent that it is not determined by functional considerations, should be in accord with the tenets of good die-casting design.

Primarily, of course, a satisfactory component design is one that can be produced fast with a low wastage rate but, in addition, the design should allow for easy flash removal and, in the case of many products that are exposed in service, should be such as to allow easy polishing and cleaning prior to the application of protective or decorative finishes. To a considerable degree these requirements are identical; smoothly faired contours, for example, promote steady and unimpeded cavity filling, as well as facilitating buffing and spray painting.

Sharp changes of direction in the flow of the molten metal stream are undesirable, since they necessarily result in a reduction of velocity and, in addition, may so affect the form of the stream as to trap air behind the advancing forefront of the metal. Although quite large box-like components with sharp angles, like that of the upper diagram in Fig. 1, can be readily cast, it is not realistic to expect the same quality of surface finish on such articles as can be obtained on the roughly equivalent part shown below, where changes of direction are gradual and all outside surfaces smoothly contoured.

Box-like forms, often with complex partitioning, are most frequently required in instrument mountings and housings, and for such parts high strength and rigidity must be coupled with complete freedom from distortion. The easy location of sub-assemblies often calls for hard edges and unfilleted recesses (Fig. 2 shows typical features) and these latter must often have minimum draft. Unless special care is taken, in design, two faults are likely to develop. One is distortion of the component at ejection, the other is the development of cracks, or of loci of weakness, along edges of the component where contraction stresses are concentrated.

Distortion is only likely to occur to a measurable extent in a small proportion of the die-castings actually produced, since it is only when the die temperature is marginally high—or, very rarely, marginally low—that the conditions for distortion exist in a correctly-designed die. So long as the casting is supported by an adequate bearing area of ejectors, located at points where resistance to stripping may be looked for, the casting must be ejected squarely from the die and no distortion can occur. If, however, the die temperature rises locally to such an extent as to seriously impair heat transfer from the cooling casting to the die, the latter may crush at ejection beneath the thrust of the ejector, as in Fig. 3. The ejectors bearing upon fully-solidified metal acting normally, the result is to distort the casting in the manner shown, with much exaggeration, in the figure.

Distortion is also likely to occur in components having thin-walled partitions of considerable depth, if even a modest increase in die temperature above the norm should occur. Large vertical areas of cavity wall having little draft very readily become galled or scored when overheated, and this increases the resistance to ejection considerably. Since deep partitions entail a correspondingly long ejector stroke, individual ejectors are likely to flex if unduly stressed. The adjacent portion of the casting remains held by

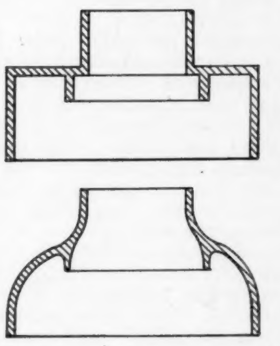


Fig. 1—Castings having smoothly blended contours as in the lower sketch are in all respects easier to produce than parts having sharp angles like that above. The larger the component, the more advantageous it is to provide for easy metal injection unimpeded by abrupt changes of direction

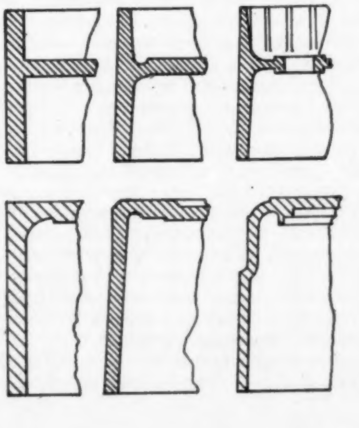
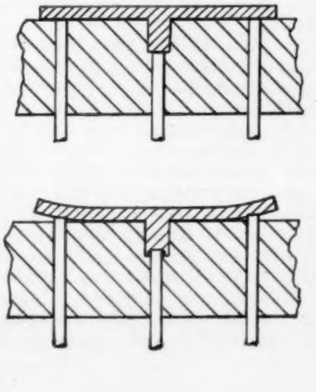


Fig. 2—Variant forms of external and internal angles; sharp corners should always be eschewed in favour of alternatives shown, each of which provides adequate surfaces for the mounting of sub-assemblies

Fig. 3—Inadequate taper of the central rib results in distortion when the ejectors are advanced as shown below



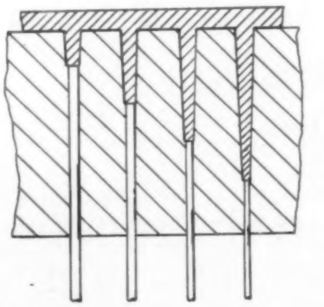


Fig. 4—For a given rib thickness, the ejector bearing diminishes in area as the depth of the rib increases, due to the cumulative effect of draft in the cavity

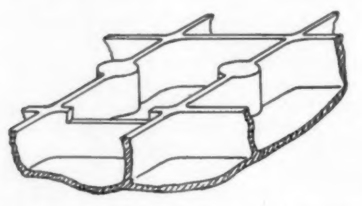


Fig. 7—Intersections of ribs provide suitable locations for ejectors, but sometimes need to be augmented by intermediate bosses as here shown

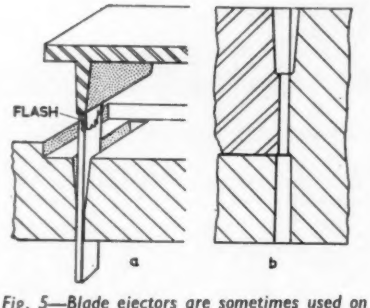


Fig. 5—Blade ejectors are sometimes used on ribs and other thin sections, but are not wholly satisfactory

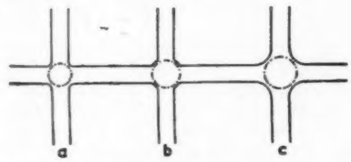


*Fig. 8—A slight radius on the corners of the adjacent cells allows ejectors appreciably larger in diameter than the rib width to be fitted. Small bevels as at **b** still further increase the available area, but the large radii of sketch **c** leave too great a mass of metal at the intersection and so are unsatisfactory*

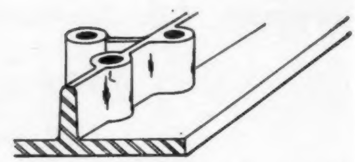


Fig. 6—A group of bosses associated with a stiffening rib

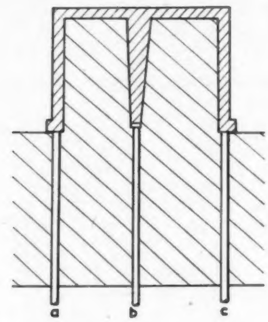


Fig. 9—Differential contraction may leave certain portions of a casting unsupported at ejection

the die until the action of the surrounding ejectors overcomes the resistance engendered by the galled surface. By that time, however, severe distortion of the component is evident. It is, in fact, not uncommon for castings to fracture during ejection under circumstances such as are outlined above, the broken portion remaining firmly wedged in the cavity.

The designer's contribution to the avoidance of distortion is the provision of adequate bearing surfaces for ejectors. It often seems to happen that, while shallow dish-like components offering little resistance to ejection are well provided with ejector locations, opportunities for the placement of ejectors become less apparent as the depth of the component, and the resistance to ejection, simultaneously increase. The reason for this is, in fact, evident from Fig. 4. As the depth of the septum increases, the draft on the face entails a rapid reduction in thickness and, accordingly, ejectors of smaller and smaller diameter are necessary.

The risk of ejector flexure or breakage increases as ejector diameter is reduced and the length of stroke is extended, whilst the bearing area per ejector is also lessened and, in consequence, more ejectors must be fitted to provide the same support. From an operational standpoint it is highly undesirable to use a large number of small diameter ejectors in place of a few well-placed ones of stouter section, since tools with many small ejectors are subject to frequent failure. Although the replacement of a broken ejector is a quick and easy operation, and the cost of the ejector itself is only a few shillings, the lost production of the machine is a serious matter. A two-hour breakdown on a large die-casting machine may mean the loss of, say, 180 castings selling at £40 per 100, with virtually no offsetting saving in costs apart from the reduced metal throughput.

So far as possible, a die-caster makes allowance for the probable incidence of minor breakdowns when drawing up an estimate, and quite small alterations in non-functional features of a design, where they affect tool reliability, may appreciably cheapen a product. The provision of adequate ejector locations, particularly on components of thin section and box-like form, is one of the simplest ways in which the designer may contribute to efficient and economical production. It is, in fact, likely to produce a casting that is generally of higher quality, since both soundness and surface finish can be maintained more easily at a high level when an uninterrupted rhythm of machine operation, not slowed by the need to nurse along a difficult die, is practicable.

It will have been noted that reference has been made above only to "pin" ejectors—those of circular section. In extreme need, where there is positively no possibility of providing adequate ejection thrust by means of pin ejectors, the use of non-circular ejectors is occasionally resorted to. However, these are expensive to fit and replace, and are never comparably reliable in operation. Virtually the only type of non-circular ejector likely to be generally considered at the present time is that depicted in Fig. 5. Here, the ejector has the form of a slender blade bearing upon part of a thin rib. As pin ejectors could not exceed in diameter the width of the blade, it is seen that a considerable increase in effective bearing area is obtained.

The disadvantages of the method, nevertheless, preclude its use when any other possibility is present. It is extremely difficult to keep the face of a blade ejector exactly flush with the face of the rib upon which it bears, and the traces of the ejector, whether proud or recessed, are less easy to mask than in the case of pin ejection. Additionally, blade ejectors are very prone to galling and seizure, so that it is necessary to give them larger clearances in their housings. Since the housings themselves must be drifted through the die block (or milled, if at the junction of two elements, as at *b* in Fig 5), it is seldom possible to maintain the original good fit when the assembly becomes worn, and heavy flash often develops, as indicated in the figure.

This expedient may be avoided in many instances by providing buttresses at intervals along the rib, either symmetrically disposed or to one side of it, as shown in the sketches of Fig. 6. Quite often, of course, buttresses of this sort are required for the attachment of sub-assemblies, being cored or subsequently drilled and tapped. The likelihood is, nevertheless, that the "functional" buttresses will be both too few and too arbitrarily spaced to provide well-balanced ejector bearings. The designer should, therefore, provide additional buttresses specifically for ejector locations wherever the functional ones lie far apart. The exact positions must necessarily be determined by the clearance required for other parts at assembly.

Where a box-like die-casting is divided up into a series of cells, Fig. 7, the intersections of the partitions normally provide the main ejector locations. In many instances no others are needed. The cores for such castings are either single blocks with intersecting grooves milled across to form the cavities for the partitions, or are built up from separate sections, each coring out a cell or a row of cells. Whichever method is adopted by the die-caster, the cells must necessarily have at least a small radius at the corners to facilitate ejection. As little as a 0·015 in. radius may suffice if the need is only to prevent binding as the component is ejected, but since larger radii provide bigger ejector locations at the rib intersection (Fig. 8), it is advantageous to round off the corners of the cells wherever this is consonant with the function of the part.

The radii on the corners at an intersection should not, however, be so large that there is a marked increase in the volume of metal at the junction, since this may result in porosity or surface defects. In the case of castings produced at high speeds, there is also a likelihood that the ejectors will push into, or even through, the metal at the intersection before it has solidified. Despite this stricture, it is desirable when the intersecting ribs are particularly thin to provide for the location of an ejector larger in diameter than the rib width; in general, it is possible to provide for an ejector up to 1·25 times the rib width by a simple radius at the core corners, as at *a* in Fig. 8, Ejectors larger in proportion are preferable when the ejector stroke is long (or rib thickness below about 0·080 in.) and it is then better to bevel the corners, as shown in enlarged detail at *b*. The normal draft is, of course, required whatever the cross-section of the core.

So far as possible, ejectors should be located so that the thickness of metal above them in the cavity half of the die is reasonably even for all of them. This is a point that is frequently overlooked or misunderstood, though the reason for it is shown clearly enough in Fig. 9. Die-casting alloys in both the zinc and light-alloy groups have an appreciable contraction on cooling, and although this is in part inhibited in directions parallel to the die face, since the tendency to shrink is resisted by the core elements of the tool, there is often no comparable constraint in the direction normal to the die face. Indeed, the care with which any impediment to free ejection of the casting is eliminated from the cavity clearly facilitates free contraction also.

In shallow die-castings the effect is negligible, but if free contraction takes place over a depth of 5 in. or 6 in., as in the figure, there exists at the moment of ejection a gap of perhaps 0·010 in. or more between the tip of the ejector and the casting itself. The result is that, as ejection commences,

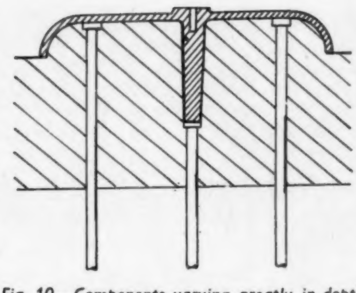


Fig. 10—Components varying greatly in depth from one point to another are particularly liable to distortion

Fig. 11—Alternative methods of equalizing ejector thrust

ejectors at *a* and *c* (Fig. 9) are in contact with the casting and ejector *b* is not; the outer rim of the component is thus lifted from the die face while the inner stem is still stationary. The face of the component is, accordingly, dished slightly inward, and although the stresses set up before ejector *b* exerts thrust are seldom enough to have any seriously deleterious effect upon the strength of the casting, it may be necessary (if the internal height is a critical dimension) to correct the distortion in a planishing operation.

It should be noted that the effect described above occurs also in components like that of Fig. 10, where the external and internal depths are substantially identical. Here, too, shrinkage occurs freely on the inner stem, both axially and transversely. The outside wall, however, is prevented from contraction prior to the opening of the die, and by the time the die is opened transverse contraction holds it so firmly to the core—on the surface of which there are always minute asperities—that little axial shrinkage can occur.

It is not intrinsically difficult to overcome these disabilities; either the whole array of ejectors may be arranged so that each bears upon a surface that undergoes no contraction displacement, or all may be disposed in such a manner that contraction affects them more or less equally. The first alternative is seen in Fig. 11 (left), where, instead of an ejector bearing upon the rib, ejectors are located close to the rib on each side. These ejectors, and those bearing upon the flange, come into action simultaneously.

On the right of the figure the second alternative is depicted. The pin bearing upon the rib is retained, but those previously bearing upon the flange are moved outward and shortened, so that they act against deep, slender lugs gated to the casting. These latter being free to contract, the ejectors all come into contact at the same time. This second method has the advantage that

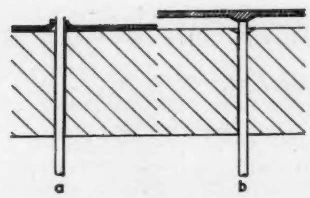


Fig. 12—Locating ejector pads on thin sections reduces the chance of ejectors pushing through

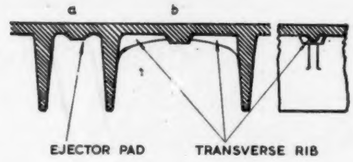


Fig. 13—Positioning ejector pads between ribs

the flange is free of all traces of ejection after the lugs and the associated flash have been trimmed off, whereas castings having ejectors bearing directly on a flange or other critical surface (as on the left) often require a belt-grinding or equivalent operation. It is, as will be evident, also a method that demands nothing of the designer, since the provision of the "outboard" lugs, and their positioning, is a matter for the die-caster's discretion.

The placing of ejectors on each side of a rib, bearing upon the web of the casting, is, by contrast, a procedure that operates most satisfactorily when the location of the ejector positions has been previously decided between buyer and die-caster and when, if possible, special provision has been made for pads at the prescribed locations. Since the main purpose of ejectors located as in Fig. 11 (left) is to overcome the resistance to ejection of the rib itself, they are the more effective the closer they are to the rib cavity. Unfortunately, if the ejector housing is very close to the cavity wall it quickly becomes overheated, and lubrication is made difficult; if the ejector is moved further away to avoid this, it is likely to punch through the web of the casting (as at *a* in Fig. 12) when for any reason the rib develops a tendency to stick in the cavity.

To reduce the incidence of this particular fault—more strictly, to make possible the attainment of a higher operating speed without it occurring—the minimum provision is that shown at *b* in Fig. 12. Here, a small pad, formed by shortening the ejector and countersinking its seating, is added to the underside of the web. The shallow countersink spreads the thrust of the ejector over a wider area of the web proper and thus reduces the likelihood that the pin will push through. There is generally no advantage in making the pad deeper than the web thickness; if too thick a pad is specified, a slight sinking of the upper surface occurs. This may hardly be noticeable on the

raw casting but can, nevertheless, be very obvious when the polished component is viewed obliquely.

Where several ribs are parallel or radially convergent, the ejector pads are best placed centrally in the space between, and located, if possible, at a point where the width of the core between the rib cavities (*a* in Fig. 13) is at least three to four ejector diameters. If ejectors are to be located additionally at positions where the ribs are more widely spaced than this—six to eight ejector diameters apart—it is advantageous to incorporate a shallow transverse rib (*b* in Fig. 13) joining the pad to the main ribs. The added rib should be narrower than the main ribs, which, of course, are appreciably thicker at the junction with the web than at the tip, and its depth should be less than the web thickness. Satisfactory proportions are shown in the figure.

(To be concluded)

Scrap Metal Baling

EFFICIENT scrap metal baling is largely a scrap handling problem, and where large volumes of scrap metal have to be dealt with, the hydraulic baling press provides the obvious solution. Such scrap may be in the form of clippings, shearings, off-cuts, waste oil drums, waste oil tins and other tins, etc., and general light sheet metal scrap. For heavier material, however, specially designed equipment may be required, and an example of heavy scrap baling is provided by a machine recently completed by Fielding and Platt Limited, of Atlas Works, Gloucester.

This machine, the Fielding 270/360/480 T type triple-compression hydraulic scrap metal baling press was designed for Colville Limited to carry out the baling of heavy grade scrap metal. The machine is fully self-contained, incorporating its own high pressure pump system, supply tank, control valves and hydraulically-operated hopper. Some idea of its size and capacity is given by the following:—

The hopper capacity is 300 ft^3; it has a box size of 9 ft × 7 ft × 3 ft. deep, and a box volume of 189 ft^3. The bale size is 24 in × 22½ in × approx. 56 in. (variable). Depending on the loading of the box and the class of material, the bale weight is approx. 1 ton.

Maximum hydraulic working pressure is 3,000 lb/in^2, and the ram strokes are:—cover ram, 6 ft. 5 in.; secondary ram, 7 ft. 1½ in.; final ram, 11 ft. 3 in. The estimated output of the baler is about 20 tons/hr. of baled scrap.

Movements of the baler are controlled from a console type desk, selection of operating conditions being made by a hand wheel selector. Indicator lamps and pressure gauges on the panel ensure the operator has full information of the press motions.

To prevent the press being operated out of cycle, electrical interlocks are incorporated, the functions of which are as follows:—(a) to prevent the hopper being operated until all the pressing rams are returned and the box is open. (b) To ensure the secondary pressing rams have completed their stroke before final pressing commences. (c) To prevent the ejection door being closed until the final pressing ram has been withdrawn.

The scrap in the baler box is compressed in three stages; initial compression is applied over the whole box area by the massive hinged cover, which applies a load of 270 tons. Secondary compression, of 360 tons, is brought about by the three rams and attached thrust face, which moves along the box axis, inside the closed box. Final compression is carried out by the single ram operating at right angles to the secondary; this ram applies a load of 480 tons.

On completion of the final pressing, the ejection door is opened and the final pressing ram ejects the bale on to the pusher gear outside the baler box.

The baler box door is fitted with special steel cutting jaws that will shear through scrap hanging over the edge. These cutters can be removed for sharpening when necessary.

N.P.L.

CERTAIN changes in organization, which will become effective about the end of March, are being made at the National Physical Laboratory. The Divisions of Electricity, Metrology and Physics, and the Test House, will be replaced by three new Divisions to be called Standards, Applied Physics and Basic Physics.

The Standards Division will be responsible for all fundamental work on standards of length, mass and time; of electrical and magnetic quantities, and also of temperature. Basically it will consist of the present Metrology Division, expanded to include certain work on standards now carried out in the Electricity and Physics Division.

The Applied Physics Division will be responsible in general for work in the field of classical physics of fairly immediate value to industry (but excluding optics, all of which will continue to be done in the Light Division). The principal areas covered will be electrotechnics, acoustics, heat, and radiology.

The Basic Physics Division will be responsible for pioneering developments in certain branches of non-nuclear physics which have potential industrial applications in the less immediate future.

Men and Metals

Reorganization of certain branches of work at the National Physical Laboratory has resulted in the following staff changes. The newly-formed Standards Division is to have as its superintendent **Dr. H. Barrell,** who is at present in charge of the Metrology Division. The Test House, now becoming part of the Applied Physics Division, will be under **Mr. H. Bowley,** and **Dr. B. Wheeler Robinson,** at present in charge of Physics Division, will become superintendent of Applied Physics Division. The recently-created post of deputy-director has been filled by the appointment of **Dr. Edward Lee.** After taking his M.Sc. at Manchester University, and his Ph.D. at Cambridge University, Dr. Lee joined the Royal Naval Scientific Service in 1939 and was posted to the Admiralty Research Laboratory. In 1946, he joined the Defence Research Policy Staff at the Ministry of Defence, and from then until 1951 was mainly concerned with relating Service research programmes to the scientific effort available and Service requirements. He has been Director of Operational Research at the Admiralty for the past three years.

A further stage in the re-organization and expansion plan of British MonoRail Limited is marked by the appointment of **Mr. A. W. Kirton** as their technical representative in the South West area. For the past five years Mr. Kirton, who is an associated member of the Institute of Materials Handling, has been the South West area representative of the mechanical handling division of Fisher and Ludlow Limited, and previous to that was a draughtsman designer with Geo. W. King Limited, engaged principally in the design and layout of conveyor systems.

The appointment of **Mr. D. A. Hubbard** as a director of Aero Research Ltd. has been announced. Mr. Hubbard took up the post of works manager in 1947, having joined the company in 1939.

Appointed a director of Albright and Wilson Ltd. is **Mr. N. M. Peech.**

Changes at the Midland Sales Division of Shell Chemical Co. Ltd. have led to the appointment of **Mr. D. Meadows-Jones** as chemical sales manager as successor to **Mr. J. E. Garner,** who becomes manager of General Chemicals Department in London. **Mr. H. E. B. Jones** is now detergent sales manager, succeeding **Mr. R. A. Taylor,** who has taken over the managership of the Scottish Sales Division.

Elected to the board of Modern Engineering Machine Tools are **Mr. H. K. Snell** and **Major-General W. A. Lord.**

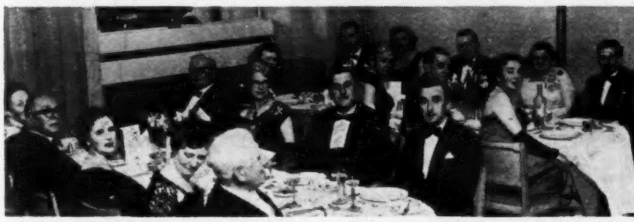
Mr. and Mrs. R. Proctor, Mr. and Mrs. Harvey, Mr. and Mrs. K. Bown, Mr. and Mrs. A. Hurst, Mr. and Mrs. J. Preston

Mr. and Mrs. C. E. Proctor, Dr. T. P. Hoar, Mrs. L. G. Beresford, Mrs. L. Bradley, Mrs. K. Drake

I.M.F.
Sheffield and North-East Branch
DINNER AND DANCE

Some of the members and guests attending the Dinner and Dance, held on February 14, at the Grand Hotel, Sheffield, are shown on this page.

Mr. and Mrs. R. A. Nicol, Mr. and Mrs. E. Hague, Mr. and Mrs. A. Maxwell, Mr. and Mrs. J. Ball, Mr. and Mrs. S. Smith, Mr. G. Gifford



Mr. A. E. Knowlson, Mr. and Mrs. H. Knowslon, Mr. and Mrs. H. Smith, Mr. and Mrs. G. L. Atkin, Mr. and Mrs. C. Rawsthorne, Mr. and Mrs. T. Corfe, Mr. and Mrs. A. R. Knowlson, Mr. and Mrs. F. Thompson, Mr. and Mrs. J. Ranby, Mr. and Mrs. B. Armitage, Mr. and Mrs. E. Mills

Mr. and Mrs. H. E. Hutchinson, Miss M. E. Hutchinson, Mr. and Mrs. S. Dobson, Mr. and Mrs. V. Moss, Mr. and Mrs. B. Woffinden

Mr. and Mrs. G. Nicol, Mr. and Mrs. T. W. Nicol, Mr. and Mrs. J. Avery, Mr. and Mrs. C. Gillam, Mr. and Mrs. L. Woods

Mr. and Mrs. R. W. Nicol, Mr. and Miss J. M. Sprague, Mr. and Mrs. C. Wharrad, Mrs. A. Wharrad, Mr. and Mrs. P. Neville

Dr. and Mrs. L. B. Hunt, Mr. and Mrs. R. W. Dews, Mr. and Mrs. H. R. Lovell, Mr. and Mrs. E. M. H. Joyce

Mr. and Mrs. J. Billam and party, Mr. and Mrs. J. Birmingham, Mr. and Mrs. C. W. Forster

SURVEY OF WORLD PRODUCTION AND CONSUMPTION

Copper in 1957

By PAUL E. GRAINGER, B.Sc.(Econ.), F.S.S.

FREE world smelter production of new blister copper rose by 28,000 long tons in 1957 and totalled 2,960,000 long tons, according to The British Bureau of Non-Ferrous Metal Statistics. Production of refined copper declined by 14,000 tons to approximately 3,441,000 tons; in addition, some 22,000 tons of unrefined blister by-passed the refineries and went direct into consumption channels, making a total supply from new production of 3,463,000 tons.

Consumption is estimated to have fallen 13,000 tons to approximately 3,263,000 tons. Production, therefore, exceeded consumption by some 200,000 tons during the year (200,000 tons 1956), of which a net 60,000 tons is believed to have gone into Government stockpiles. Visible world stocks of blister and refined copper rose by 149,000 tons (206,000 tons increase 1956), and totalled 995,000 tons at end 1957, excluding stocks held by all Governmental Agencies and by consumers in many European and South American countries.

The development of world production and consumption of refined copper during the year is given in Table I, in thousands of long tons.

TABLE I—QUARTERLY TOTALS

	Production*	Consumption*	Excess
1st Quarter	885	838	47
2nd „	883	839	44
3rd „	807	754	53
4th „	888	832	56
Year 1957	3,463	3,263	200

**Includes direct use of blister.*

The seasonal decline in the third-quarter consumption was no more pronounced in 1957 than in previous years.

Smelter production fell by 44,000 tons in the U.S.A. and by 9,000 tons in Chile and 7,000 tons in the Belgian Congo, but there were increases of 32,000 tons in Northern Rhodesia, 3,000 tons in Canada and 13,000 tons in Japan. These six countries accounted for 87 per cent of free world smelter production during the year (86 per cent in 1956). Production in other countries rose by 40,000 tons.

Production of refined copper included some 500,000 tons recovered from secondary material; the overall decline in total output compared with the increase in smelter production was due mainly to an increase in stocks of blister awaiting refining. Production fell slightly in most producing countries, except Northern Rhodesia and Japan where there were increases of 21,000 tons and 14,000 tons respectively.

The decline in world consumption was due mainly to conditions in the U.S.A. and Canada, where consumption fell by 153,000 tons and 25,000 tons respectively. Consumption rose 6,000 tons in the United Kingdom and there were increases in most other European countries, with the result that consumption in Western Europe reached a new high of 1,549,000 tons. There were some signs of falling off towards the end of the year, however. Japanese consumption was 29,000 tons higher than in 1956; this was mainly due to high rates in the early part of the year, consumption in the last quarter being well below the 1956 rate.

World production and consumption during the last two years are compared in Table II.

TABLE II—FREE WORLD PRODUCTION AND CONSUMPTION

	Smelter Production (excluding secondary)		Refinery Production (primary and secondary)		Consumption (primary and secondary)	
	1956	1957	1956	1957	1956	1957 (provisional)
U.S.A.	1,099	1,055	1,521	1,505	1,358	1,205
Canada	286	289	295	289	130	105
Chile	452	443	237	218	17	8
Northern Rhodesia	388	420	226	247	—	—
Belgian Congo	245	238	124	120	—	—
Germany	55	54	250	249	352	397
U.K.	—	—	218	204	502	508
Other European	107	119	338	326	613	644
Japan	91	104	124	138	146	175
Elsewhere	209	238	122	145	158	221
Add: blister for direct consumption			21	22	*	*
TOTAL	2,932	2,960	3,476	3,463	3,276	3,263

Figures given in thousands of long tons.
**Included in consumption for individual countries as appropriate.*

Research Progress—*continued from page 170*

continued from page 170

and Lennox do not seem to have been interested in the mechanism by which their improvements were achieved. At no point do they discuss this problem, nor do they appear to have made any attempt to elucidate the processes involved. They do, however, discuss another matter which might have some bearing on this subject. They were apparently worried that intergranular corrosion, known to occur in zinc-based die-casting alloys containing both aluminium and cadmium, might impair the lives of zinc anodes containing additions of these latter two elements. They, therefore, carried out some tests which indicated that this type of attack would not present a serious practical problem. Nevertheless, the fact that zinc with aluminium plus cadmium additions does tend to behave somewhat abnormally under corrosive conditions might have shed some light on the effectiveness of such additions in improving consumable anode performance. The collection and examination of the corrosion products from the anodes might also have shown why the additions modify the type of product obtained.

Reference

[1] E. C. Reichard and T. J. Lennox: *Corrosion*, 1957, **13** (6), 68.

Industrial News *Home and Overseas*

Plastic Steel

Until now available only under licence from the United States, "Devcon," the plastic steel, is being manufactured within the Commonwealth and is available, ex stock, in London, Glasgow and Sheffield. **E. P. Barrus (Concessionaires) Ltd.,** who introduced the material to this country some two years ago, have now established two new companies which, in association with the home company, will provide stocking facilities for England, Scotland, and Northern Ireland.

The new companies are Smail-Barrus Associated, 21-23 India Street, Glasgow, who will cover Scotland and Northern Ireland, and Tasker-Barrus Associated, Blonk Street, Sheffield, who will operate in South Yorkshire, Derbyshire, Nottinghamshire and Lincolnshire. The London office of the home company is at 12-16 Brunel Road, Acton, London, W.3.

Manchester Office

An announcement from **The British Aluminium Company Ltd.** is to the effect that on Tuesday, March 25 next, the Manchester branch sales office of the company will be transferred from its present address in Fountain Street to Woolwich House, 59-61 Mosley Street, Manchester, 2. The telephone number of the new office is Central 2331.

Dark Smoke

Readers are reminded that, as from June 1 next, it will be an offence, with fines up to £100, to emit dark smoke from chimneys. This is the principal effect of an Order recently laid before Parliament by the Minister of Housing and Local Government. The Order names June 1 as the second appointed day for the Clean Air Act, 1956, and on that day all the remaining provisions of the Act will be brought into operation.

The dark smoke ban will apply equally to factories, shops and offices and the funnels of ships and railway engines. House chimneys will be subject to it, but in practice they rarely produce "dark smoke," which is defined as smoke as dark as or darker than Shade 2 on the Ringelmann Chart. The Act allows certain defences in the event of proceedings, e.g. if it can be proved that dark smoke was solely due to lighting up a furnace from cold or to mechanical failure.

In addition to the ban on dark smoke, the Clean Air Act will require a reduction in emissions of grit and dust from June 1. After that date, all new furnaces installed for burning pulverized fuel, or more than one ton an hour of other solid fuels, will have to be equipped with grit- and dust-arresting plant approved by the local authority. In the case of other new and existing furnaces, except for small domestic boilers, failure to take practical steps to minimize grit and dust will be an offence.

Aluminium Alloy Underframe Pedestal

In the construction of light alloy commercial vehicle bodywork, the provision of cross-bearer supports or "underframe stools" to give adequate rear-wheel clearance as simply and effectively as possible has long been a test of the designer's ingenuity. A die-cast aluminium underframe pedestal, which is now available from **Northern Aluminium Limited,** by providing a unit ready for mounting, should appeal to both the small and large body builder, and enable the costs to be considerably reduced.

The makers state that the advantages of this new cast unit lie in the facts that the most efficient use of the metal has been made and that the labour involved is reduced to that of fitting three bolts between cross-bearer and pedestal, and mounting the bearer assembly to the chassis with a "U" bolt. The retaining groove for the bolt is so positioned as to ensure that the pedestal is always in compression, thus making the best possible use of the properties of the casting, which is in Noral 117 alloy (B.S.1490 LM4M).

Self-Adhesive Nameplates

A recent development in the production of metal nameplates has been announced by **Millett, Levens (Engravers) Limited,** of Boreham Wood, Herts. This company is now able to offer self-adhesive metal and plastics nameplates which appear to be very simple in operation. All that is necessary to manipulate these plates is to immerse them in water, preferably warm, for a few seconds. This enables the protective film on the back of the plate to slide off. They are then ready to apply, merely by firm pressure, to almost any surface which is clean and free from dust.

The cost of drilling or riveting is entirely eliminated and the nameplate can now be applied to parts previously considered inaccessible. We understand that all conventional types of metal or plastics nameplates, dials, scales, etc., produced by this company, can now be supplied in this self-adhesive form, which the firm rightly term a revolutionary process.

Change of Address

As from Monday last (February 24), **Foxboro-Yoxall Ltd.** have been accommodated in their new offices at Redhill, Surrey, with the new telephone number of Redhill 5000. This new expansion takes into account not only the increased production now required but also the need to reduce their delivery period in the near future. It is understood that the company has also taken the opportunity to expand in every department of the concern, particularly in technical sales and service facilities.

Brazilian Aluminium Plant

It has been officially announced in Rio de Janeiro that the Government is to set up a large aluminium plant on the borders of the States of Bahia, Pernambuco and Alagoas. Bauxite produced in the north-east of Brazil will be used as the raw material.

Out of the Melting Pot

Under this heading in our issue of February 14 (page 126), a note concerning high-temperature cements was included, special reference being made to a high-temperature cement composition developed by **Bristol Aero Engines Ltd.** In this connection we are glad to add the information that this cement is being manufactured and marketed by **The Morgan Crucible Company Ltd.** under the trade name of "Brimor."

Two "Brimor" compositions are now available commercially:—types U.527 and U.529, and supplies are usually from stock in 1 lb. lots. The cements are particularly suited to heat-resistant steels and Nimonic alloys, and when applied to these materials have an operating range up to temperatures of the order of 750°C. They can, however, be applied with equal facility to the low alloy steels, cast iron, and also to some non-ferrous metals such as brass, titanium, copper and aluminium alloys.

Metal Finishing

On Thursday of next week (March 6), the North-West branch of the **Institute of Metal Finishing** will hold a meeting at the Engineers' Club, Albert Square, Manchester, at 7.30 p.m. A Paper will be presented by Mr. F. H. Wells on "Chemical Polishing of Metals."

Arc Melting Furnace

News from **William Jessop and Sons Ltd.** is to the effect that they have ordered from W. C. Heraeus, of Western Germany, through their U.K. agents, Feischmann (London) Ltd., a consumable electrode arc-melting furnace. This furnace is required by Jessops as an addition to their existing vacuum-melting production plant, and will be used for the production of "Vacumelt" steels and "Hylite" titanium alloys, or of any other material that lends itself to this type of melting.

Brass Strip

The Export Services Branch of the Board of Trade have been informed by the British Consulate-General in New York that the Capital Cubicle Company Inc., of 213 Twenty Fifth Street, Brooklyn, 32, N.Y., are interested in obtaining a source of supply in the United Kingdom for the following materials:—

Brass strip in welded coils of approximately 700-800 lb. per coil, about 3 in. wide; brass strip formed into 1 in. outside diameter tube with an open slot along the length.

The quantities involved would be in shipments of 100,000 lb. lots, which the American company would import for their own account. Interested U.K. firms are advised to contact the enquiring company direct by air mail. It is stated to be important that quotations should show both f.o.b. and c.i.f. prices in U.S. dollars.

Italian Statistics

Figures issued recently in Rome show that in the first 11 months of 1957 Italian imports of crude copper, and copper for smelting and refining, amounted to 6,589·7 metric tons, valued at 3,014,950,000 lire, whereof 253·7 metric tons were imported temporarily, according to the Central Statistical Office. Main suppliers were (in metric tons) Rhodesia and Nyasaland 808·6 tons; South Africa 2,432·9, and Chile 2,990·9 tons.

A further 97,310·9 metric tons of crude and refined copper in slabs, ingots, shot and powder form, valued at 42,826,994,000 lire, were imported, of which 9,977.3 metric tons were imported temporarily. Main sources were: Belgium-Luxembourg 5,601.3 metric tons; West Germany 1,618·1; Britain 9,539·8; Belgian Congo 13,552·5; Rhodesia and Nyasaland 9,507·9; South

Africa 5,558·1; Chile 21,163·6; and the United States 27,209·2 metric tons.

In the first 11 months of 1957, Italy exported 938 metric tons of quicksilver, valued at 4,059,544,000 lire. Main outlets were (in metric tons): Austria 34; France 150·4; West Germany 202·8; Britain 112·1; Japan 92·4; India 16·8; Brazil 139·7; and the United States 143·1.

Brazilian Lead

In the second half of this year, a lead plant with an annual output capacity of some 12,000 tons will go into operation at Santo Amaro, near Sao Paulo, according to *Journal do Comercio*. In the meantime, a second lead plant with an annual capacity of 8,400 tons is being completed at Nova Iguacu, in the State of Rio de Janeiro.

Capacity is put at about 8,000 tons per year, and it is anticipated that output next year will be around 20,000 tons, or close to the then current level of consumption. (In 1956, production was 4,498 tons, and imports amounted to 10,363 tons.) At present, annual requirements comprise 9,000 tons for batteries, 3,500 tons for cables and electrical purposes, 2,500 tons for pigments, etc., and 1,500 tons for various other purposes.

Lightweight Containers

A special demonstration was given in London last week by **The British Aluminium Company Ltd.** of a range of materials handling containers of entirely new design which have been made by **Light Alloy Construction Ltd.** These containers, known as "Tracon," are made of aluminium alloy, specially toughened, with hardened steel corners to withstand many years of rough handling. They are collapsible, pilfer-proof and non-corrodible, and the makers state that they may be used for the safe transit of practically every type of merchandise.

The Tracon container is hinged along the entire length and breadth of each collapsible side, with the locking clips riveted to the tough metal structure, so that, when locked, they defy the most determined pilferers. When emptied, these containers are collapsed and clipped for the return journey, giving one-fifth of its packed size. The maker's own description of this product is "a one-piece folding light-alloy container."

Other types of containers provided are marketed under the trade name of "Lacon," and include trolleys, general-purpose and other types, for the handling of all kinds of materials. Standard sizes of all these products are available, while special requirements can also be catered for.

New Sales Office

Notification has been issued by **Wild-Barfield Electric Furnaces Ltd.** that their Sales and Service offices, covering the Midlands area, will, on and after March 1 next, be situated at 71 Broad Street, Birmingham, 15, with the telephone number of Midland 7232.

Electro-Plating Film

From the London firm of **Silvercrown Ltd.** comes a film entitled "Automation in the Electro-Plating Industry," which shows shots of recently-installed plants for electro-plating and metal finishing in actual operation.

Fully- and semi-automatic installations for vat and barrel plating of all types of components are included. This film is a silent 16 mm. film, running for about 40 minutes. It is available on loan without charge on application to the company.

Welding News

It is learned from the **Institute of Welding** that the first of a series of annual lectures to be given by eminent scientists and engineers, which will be devoted to subjects of wide general interest, will be given in the Conference Hall of the Institute at 6 p.m. on March 12 next. The lecture will be given by Professor Sir Alfred Pugsley, O.B.E., D.Sc., F.R.S., who will take as his subject "The Influence of Welding on Structural Design."

Tickets will not be required for admission, and tea and light refreshments will be available at 5.15 p.m.

Metal Exchange and Russian Tin

According to reports within the industry, the suspension of the London Metal Exchange rule which made Russian tin tenderable against the standard contract may not last for an unduly long time. Hopes are running high that the suspension may be lifted within the near future.

Russian tin has not been accepted as tenderable since Tuesday of last week, when it was found that the same moulds and approximately the same marketings were used for two qualities of HO3 Novosibirsk. One quality was of 99·9 per cent purity, which exceeded the purity of 99·75 per cent required to satisfy the London contract; the other was of only 99·56 per cent purity and, therefore, not up to standard.

Although the exact quantities of Russian tin coming on the London market are not known, market reports and circulars suggest that the total annual output is in the region of 5,000 tons of the 99·9 per cent purity quality, and anything up to 6,000 to 7,000 tons of the other.

Rhodesian Minerals

The value of mineral production in Northern Rhodesia dropped from £130,148,615 in 1956 to £96,352,691 last year, according to a summary report issued by the Commissioner of Mines here. Figures for blister copper dropped from £47,271,995 in 1956 to £34,200,053 last year, and those for electrolytic from £73,729,521 in 1956 to £54,416,299 last year. Apart from copper, zinc again had the highest production value, but also dropped £400,000 to £2,396,028.

News from Birmingham

At a recent meeting of the Midland Regional Board for Industry, Mr. J. W. Eldridge, regional controller of the Ministry of Labour, commenting on unemployment in the Region, said there would most likely be an increase of between 2,000 and 3,000 in the unemployment figures for the month of February. No significant change has taken place in overall activity, though in some industries the tightening of the credit squeeze is having its effect. Orders in the metal trades are certainly more difficult to secure, but there is still a substantial flow of raw materials and components to the motor car factories, and the outlook in this direction is promising.

Stocks have risen in the iron and steel industry and, except for heavy steel plates, many of the accumulated orders have been cleared. Steel sheets are going straight from rolling mill to the car works, because stocks are not held in that trade. Lack of orders for light castings is causing short time and unemployment in the foundries, particularly where normal output is concerned with the building trade. On the other hand, the position in regard to heavy castings is much brighter as the engineering industries are still making big demands on foundrymen. Supplies of pig iron are ample, and scrap is more plentiful.

Key Industry Duty

An Order has been made by the Board of Trade adding the following instruments to the list of scientific instruments liable to Key Industry Duty (i.e. Key Industry Duty List No. 5):

Instruments for performing any of the following tests: bending, compression, fatigue, impact, tensile, torsion.

The Order, which is the Key Industry Duty (List No. 5—Scientific Instruments) (Amendment) Order, 1958, was published on February 14, 1958, as Statutory Instruments, 1958, No. 200, and came into operation on February 17. Copies of the Order (price 2d. net, by post 4d.) may be obtained from H.M. Stationery Office, Kingsway, London, W.C.2, and branches, or through any bookseller.

Smoke Density Indicator

A simple indicator has been recently developed by the Fuel Research Station of the Department of Scientific and Industrial Research. This device, known as the Shandon Glowring smoke density indicator, consists of a special glowing element, placed in the side flue. The element is viewed through a column of flue gas from an observation window in the front wall of the flue. The brightness of the Glowring can be adjusted so that it is obscured when the smoke density corresponds with No. 2 shade on the Ringelmann chart. This is the density which, under the Clean Air Act, must not be exceeded.

The complete equipment costs only £32. No extras are required. All the user has to provide is a small hole in the front wall of the flue and a single phase electricity supply. Complete details of this device may be obtained from the **Shandon Scientific Company Ltd.**

Bronze and Brass Founders

Notices have been issued by the **Association of Bronze and Brass Founders** relating to the meeting of the Manchester area members which is being held in Manchester on Tuesday next, March 4. This meeting will be addressed by Mr. E. C. Mantle, of the British Non-Ferrous Metals Research Association, whose subject will be "The Survey of Furnaces for Melting Copper Alloys with Cost Data Compiled under Production Conditions in Sand Foundries."

U.K. Metal Stocks

Stocks of refined tin in the London Metal Exchange official warehouses at the end of last week totalled 17,406 tons, comprising London 5,833; Liverpool 10,593; and Hull 980 tons. Copper stocks totalled 19,855 tons, and comprised London 11,322; Liverpool 6,858; Birmingham 975; Manchester 25; Swansea 425; and Hull 250 tons.

U.S. Zinc Production

Domestic mines produced 520,100 tons of recoverable zinc in 1957, a decrease of 22,200 tons, or 4 per cent, from 1956, according to the Bureau of Mines, United States Department of the Interior.

During the first four months of 1957,

total zinc production was maintained at a higher average monthly rate than the average for 1956. The price of zinc had been stabilized for 16 months at 13·5 cents a lb., East St. Louis, largely through Government acquisitions for the national strategic and supplemental stockpiles. The Government continued to purchase substantial quantities of domestically-produced zinc each month throughout the year 1957, but the barter programme, under which zinc of foreign origin was acquired for the supplemental stockpile, was greatly restricted at the end of April. On May 6, the prize of zinc dropped to 12 cents a lb., and further declines reduced it to 10 cents on July 1. This quotation held for the remainder of the year. Many mines shut down, and others curtailed production rates. Output during the last half of the year, at 228,500 tons, was 22 per cent less than the 291,600 tons produced in the first half.

Canadian Manganese

It is reported from Toronto that negotiations are being continued by Strategic Manganese Corporation for finance to construct its large-scale manganese mining and smelting operation at Woodstock, N.B. The extensive test work conducted at the prototype smelter of Strategic-Udy Metallurgical and Chemical Processes in Niagara Falls, Ontario, was completed a few weeks ago, and the electro-metallurgical process worked out has been demonstrated to be feasible and profitable on a commercial basis, a company official states.

Industry and Technical Colleges

A report of the conference on "Industry and the Technical Colleges," organized by the Federation of British Industries Southern Regional Council and held in October last year, has now been published by the F.B.I. (price 2s.). The report contains the addresses by Mr. A. A. Part, Under-Secretary, Ministry of Education, and Mr. H. A. Collinson, managing director, Leicester, Lovell and Co. Ltd., Southampton; the summing-up by Sir Henry Tizard, chairman, Southern Regional Council for Further Education; and summaries of the proceedings, including a panel discussion in which the panel members were Dr. F. M. Brewer and Mr. Howard Buckley, respectively chairman of the governing body and principal of the Oxford College of Technology, Arts and Commerce; Mr. F. L. Freeman, chief education officer, Southampton, and Mr. G. A. Hunt, director and general manager, High Duty Alloys Ltd., Slough.

Trade with Lebanon

Certain amendments have recently been made to the Lebanese Customs tariff and include the following items:—Bars and wire of copper—(a) bars of copper (2) yellow; tubes, pipes and rods of copper; former rate of duty 11 per cent *ad valorem*. now exempt.

A New Model

A new 4-ton crane has been added to the range of Jones diesel mechanical models distributed in the United Kingdom by **George Cohen Sons and Company Ltd**. The new KL 44B, as its name implies, is a modification of the KL 44. Advantage has been taken of the fact that the exceptionally high operating speeds of the KL 44, while important on such duties as grabbing, are not required by every operator needing a 4-ton capacity machine. By modifying these operating speeds, it has been possible to introduce a less powerful engine while maintaining the same lifting capacity.

The new Jones KL 44B is complementary to the KL 44 and in no way does it supersede it; full-scale production is going ahead on both models at the Letchworth works of George Cohen's associates, K and L Steelfounders and Engineers Limited.

New Process

A new phosphating process for direct application to clean sheet steel surfaces prior to painting has been developed by the **Walterisation Co. Ltd.** It is envisaged that the treatment will be suitable for manufacturers of private and commercial vehicles, refrigerators, kitchen and office furniture and partitioning, etc., where the size and shape of the articles to be treated preclude them from being treated by conventional immersion or spray process. The process will also be of value, say the company, for repair work where phosphate coatings have had to be removed locally for welding, cleaning, resurfacing or other alteration.

The process will be known as the Walterisation SPC process — this is derived from Spray Phosphate - Cold. The solution, which will be used at the strength supplied, is applied by means of a spray gun, the same type as that used for paint spraying, but the working parts should be made of acid-resisting material. An air pressure of 30 to 40 lb/in^2 should be used, and the SPC chemical must be contained in a glass or acid-resisting container.

The technique of application is extremely simple, it is stated, consisting of degreasing, phosphating, washing, and then drying. Degreasing may be carried out by wiping with white spirit, trichlorethylene, thinners, or other suitable organic solvent. The surplus solvent is then removed from the surface by wiping with a dry rag. Full details of this process may be obtained from the company.

Billiton Decision

An announcement has been made by the Indonesian Government that it has decided not to prolong the existence of the mixed Dutch and Indonesian enterprise known as the NV Gemeenschappelijke Mijnbouw Maatschappij—the Billiton tin mine. In a statement, the Ministry for Industry said the mines would be operated directly by the Government as from March 1. Tin production would go on normally and, after the take-over date, tin from Bilitung Island would appear on world markets with the same mark and quality as hitherto.

Tin Statistics

World production of tin-in-concentrates for the whole of 1957 is estimated at 171,000 tons, according to the Statistical Bulletin issued by the International Tin Council. The figures available for December show a sharp decline in production in Indonesia but some rise in Malaya.

Smelter production of tin metal fell sharply from 15,000 tons in October to about 14,700 tons in November. It is estimated that world production for the full year 1957 will be 170,000 tons, compared with 177,000 tons in 1956.

World consumption of primary tin metal during October, 1957, was 13,000 tons, or about the same level as in the previous three months. On the basis of the first ten months of 1957, consumption for that year is estimated at 161,000 tons, as compared with 160,000 tons in 1956. The recent monthly movement in consumption of tin in the United States has been downwards (taking into account the fall in the production of tinplate). The movement in the United Kingdom in the last quarter of 1957 was also downwards.

During December, mine production of tin-in-concentrates in Nigeria was 693 tons, and in Thailand 1,421 tons. In Indonesia during January it was 1,927 tons. Tin metal production in Malaya during November was 5,120 tons, and during December 5,486 tons, and exports in January 6,738 tons. Exports of tin-in-concentrates from Nigeria in December were 945 tons.

Imports of tin metal into Canada in October were 550 tons; into the U.S.A. in November, 3,780 tons; into France (including the Saar) in December, 1,383 tons; and into the Netherlands in December 979 tons, of which 955 tons came from the U.S.S.R. Consumption of primary tin metal in the United States in October was 4,195 tons (revised) and in November 3,590 tons.

Incentives in Industry

Views on the value to industry of financial incentive schemes are greatly varied: some concerns have recently abandoned long-standing schemes, while others have only just embarked upon them.

Why these changes have come about will be discussed at a one-day conference on financial incentives organized by the **Industrial Welfare Society.** The conference will also attempt to analyse where incentives can be best applied and under what conditions. The conference will be held on Tuesday, March 25, at Robert Hyde House, 48 Bryanston Square, London, W.1.

Forthcoming Meetings

March 4—Institute of Metals. Oxford Local Section. Cadena Café, Cornmarket Street, Oxford. "Nucleation and the Cast Structure." V. Kondic. 7 p.m.

March 4—Institute of Metals. South Wales Local Section. Department of Metallurgy, University College, Singleton Park, Swansea. "Metals for High Temperature Service." W. Betteridge. 6.30 p.m.

March 4—Institute of Metal Finishing. Midland Branch. James Watt Memorial Institute, Great Charles Street, Birmingham, 3. "How to Make the Best of Bright Nickel Plating." A. Smart. 6.30 p.m.

March 5—Institute of Metal Finishing. Scottish Branch. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow. "The Structure of Metal Surfaces." T. P. Hoar. 7.30 p.m.

March 6—Institute of Metal Finishing. North-West Branch. Engineers' Club, Albert Square, Manchester. "Chemical Polishing of Metals." F. H. Wells. 7.30 p.m.

March 6—Leeds Metallurgical Society. Lecture Room C, Chemistry Wing, The University, Leeds, 2. "Some Metallurgical Problems of Nuclear Energy." H. K. Hardy. 7.15 p.m.

Metal Market News

CONTRARY to expectations, the January copper statistics, issued by the Copper Institute, made a good showing, but cautious estimates of these figures lead to the conclusion that it will be wise to await the February totals before jumping to the conclusion that there has been a turn round in the tempo of trade. Details are as follows, shown in short tons of 2,000 lb.: inside the United States, production of crude copper was 108,264 tons, a gain of 4,366 tons on December, while output of refined, at 136,748 tons, was 613 tons higher than in the previous month. Deliveries of refined copper to consumers amounted to 109,707 tons, which showed an advance of no less than 25,261 tons. Stocks of refined copper in the hands of producers at January 31 were 176,287 tons, or 4,737 tons lower than a month earlier. This was the big surprise, for most people anticipated a sharp increase, not a fall. Outside the United States a somewhat similar trend was in evidence, for there was a rise of 6,014 tons in the output of crude copper to 156,537 tons, but a fall of 3,032 tons in refined production to 125,105 tons. Deliveries to consumers amounted to 150,171 tons, this total registering an increase of 16,270 tons on December. Stocks of refined copper were 272,613 tons, which showed a drop of 4,703 tons compared with December. The United States January zinc figures showed a sharp fall in production to 82,343 short tons, this being some 11,000 tons below the previous month, while deliveries amounted to 68,657 tons. Stocks, at 180,346 short tons, showed an increase of 14,000 tons.

All the metals showed some improvement last week, although the background was unchanged, with the American situation certainly no better. Wall Street sessions were the reverse of encouraging and rather droopy conditions obtained on the London Stock Exchange. Unemployment figures show some signs of increasing, and, one way and another, the outlook is not very encouraging. A bright spot is the activity in this country of the motor car industry, which very definitely helps the non-ferrous trade, particularly the rolled metal section. As we write, the January statistics for the U.K. are not yet available, but it is anticipated that they will make a better showing than December. As mentioned above, last month in the States was good, and outside the United States also. On the standard copper market last week the turnover was 6,125 tons, excluding deals put through on the Kerb. As already mentioned, the tone was fully steady, and on balance cash gained £3 and three months £3 10s. 0d., the contango widening to 30s. at the close. In the States, values remained unchanged, but on Friday afternoon's session there was a rumour that the custom smelters had reduced their official quotation to 23 cents again. There was a reduction of 350 tons in L.M.E. stocks to 19,505 tons, so that if copper is being shipped away from this country to the States, the rate of withdrawal is not very rapid.

In tin, stocks were increased by 162 tons to 16,616 tons and the market was firmer, cash closing £4 10s. 0d. up at £736 and three months £6 10s. 0d. higher at £738, these quotations, however, being below the best. The turnover was 905 tons. The Chinese New Year holiday made for quieter conditions in the East but the Singapore market was quite firm, and it is obvious that people are now thinking much more favourably of the outlook.

Since throughout the week the cash quotation was above the Tin Pool floor price, there was no need of any support buying, and there is no reason to suppose that any metal was acquired by the Tin Council. More interest is reported from the United States, where consumers must have allowed their stocks to fall to a very low level. About 3,200 tons of lead changed hands, February advancing by £2 to £76 and May by £1 15s. 0d. to £75 15s. 0d. In zinc there was a turnover of 2,900 tons with a gain of 7s. 6d. for prompt and 5s. forward. Closing prices were £64 2s. 6d. February and £63 17s. 6d. May.

New York

There was little change in the non-ferrous metal market for the past week. Electrolytic copper continued to be priced at 23½ cents per lb. by custom smelters and 25 cents by producers. Custom smelter copper sales were spotty, while producers reported routine business. Copper sources were encouraged by the favourable Copper Institute statistics for January, wherein shipments rose sharply from the December total, both in the U.S. and abroad, while producer stocks, both in the U.S. and abroad, were trimmed a bit below December. However, U.S. shipments were lower than those of a year ago, and stocks both in the U.S. and abroad were well above January, 1957.

Some copper analysts said that the January figures might have been distorted in the U.S. shipment category because of postponed December deliveries on tax considerations. These sources also said that February figures might more accurately reflect the deepening economic recession in the U.S. The problem in copper, these sources said, was still one of overproduction. But recent cutbacks instituted on a world-wide basis should soon be showing up in the market, they added. However, a disturbing factor which could only mean further cutbacks in production was the falling-off of copper business in February. Brass mills reported that February business, new orders and shipments, was falling below the January rate and was considerably below a year ago.

One official said U.S. producer prices were unrealistic and the much lower foreign copper price was giving the foreign manufacturer a "big competitive advantage."

One leading seller of lead and zinc reported fair sales during the week in both metals, but other sellers reported quiet conditions. St. Joseph Lead announced that it would curtail lead production next month in a move to take 6,000 tons off the market. Informed trade sources said it appeared that the Tariff Commission might take until March before it made known its recommendations on tariff rises for lead and zinc. These sources said it appeared that the Administration, in order to pave the way for a five-year extension of the Reciprocal Trade Agreement Act, was quietly linking the passage of the trade agreement extension with Government aid for U.S. lead and zinc producers.

Tin was steadier during the week on improved dealer buying. However, this buying activity was confined mostly to nearby tin and reflected covering of needs.

Zurich

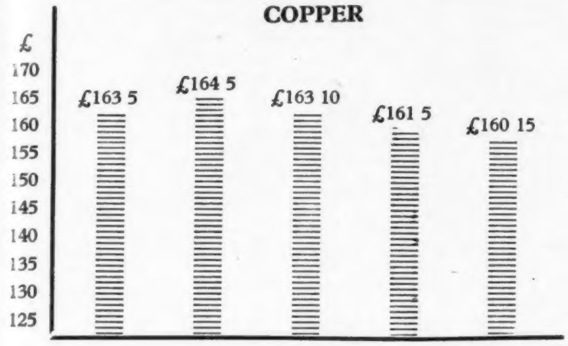
The Swiss non-ferrous metal market has continued to display very marked weakness during the past few weeks. Importers took advantage of the low price structure to buy certain amounts of metal, but sales to fabricators were extremely slow, particularly in the case of copper. Lead and zinc were in somewhat better demand. For the first time, in January, Soviet lead appeared on the Swiss market, which has handled Soviet tin for several months. Trade circles said prices of the Soviet lead were competitive, and expected imports to continue.

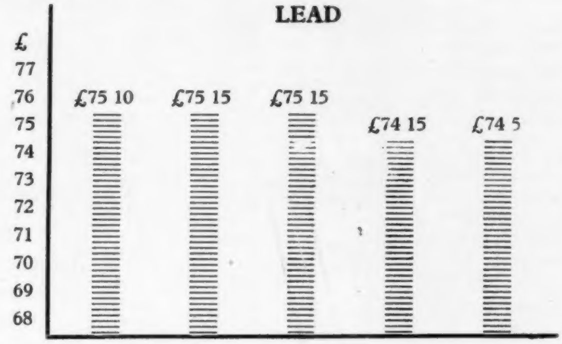
India

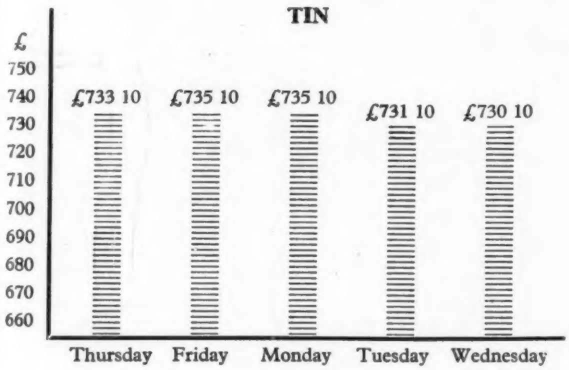
The Bombay Government is examining the possibilities of setting up an aluminium plant—about 20,000 tons capacity per year—near Kolhapur, in Bombay State, where plentiful bauxite deposits have been located. The State Government has already approached the National Planning Commission to include this plant in the public sector in the second five-year plan. The Planning Commission, well-informed sources here say, has taken a favourable view of the project, although it has not yet reached a final decision in this connection. Meanwhile, the State Government is going ahead with the collection of necessary preparatory data and other exploratory field work.

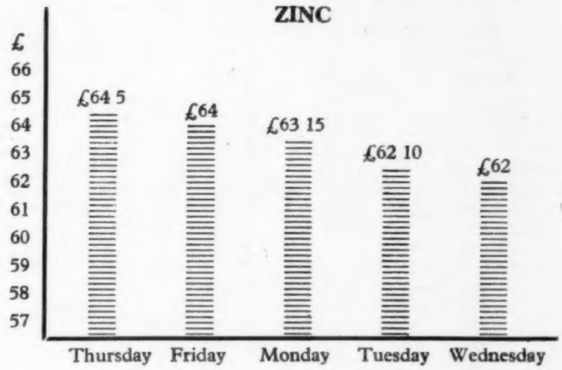
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 20 February 1958 to Wednesday 26 February 1958









OVERSEAS PRICES

Latest avaliable quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏ £/ton	Canada c/lb	≏ £/ton	France fr/kg	≏ £/ton	Italy lire/kg	≏ £/ton	Switzerland fr/kg	≏ £/ton	United States c/lb	≏ £/ton
Aluminium			24.63	203 10	210	182 15	400	232 0	2.50	209 0	28.10	224 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,400	1,218 0	2,550	1,479 0			155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							340	197 5				
Electrolytic	23.00	168 2 6	24.50	202 7 6	216	188 0			2.00	167 5	25.00	200 0
Lead			12.25	101 2 6	123	107 0	182	105 10	.95	79 10	13.00	104 0
Magnesium												
Nickel			71.50	590 10	1,205	104 17 6	1,330	771 10	7.70	643 17 6	74.00	592 0
Tin	100.75	736 10			906	788 5	1,400	812 0	8.77	733 7 6	94.87	759 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	159	92 5	.82	68 10	11.75	94 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 26/2/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	197	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99% ..	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	13	18	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite .... per unit			—	
Copper H.C. Electro ..	ton	160	15	0
Fire Refined 99·70%	„	159	0	0
Fire Refined 99·50%	„	158	0	0
Copper Sulphate	„	64	0	0
Germanium	grm.		3	4
Gold	oz.	12	9	4½
Indium	„		10	0
Iridium	„	27	0	0
Lanthanum	grm.		15	0
Lead English	ton	74	5	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	76	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	7	10	0
Platinum	„	26	15	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	4⅝
Tellurium	lb.		15	0
Tin	ton	730	10	0
Titanium	lb.		19	6
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	62	1	10½
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+% ..	„	87	1	10½
Granulated 99·99+%	„	99	17	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	227	0	0
B.S. 1490 L.M.6	„	217	0	0
B.S. 1490 L.M.7	„	231	0	0
B.S. 1490 L.M.8	„	220	0	0
B.S. 1490 L.M.9	„	218	0	0
B.S. 1490 L.M.10	„	236	0	0
B.S. 1490 L.M.11	„	231	0	0
B.S. 1490 L.M.12	„	240	0	0
B.S. 1490 L.M.13	„	231	0	0
B.S. 1490 L.M.14	„	241	0	0
B.S. 1490 L.M.15	„	227	0	0
B.S. 1490 L.M.16	„	222	0	0
B.S. 1490 L.M.18	„	220	0	0
B.S. 1490 L.M.22	„	228	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	153	10	0
B.S. 1490 L.M.2	„	160	0	0
B.S. 1490 L.M.4	„	182	10	0
B.S. 1490 L.M.6	„	205	0	0

†Average selling prices for December.

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	199	0	0
BSS 1400 AB.2	„		—	
***Brass**				
BSS 1400-B3 65/35 ..	„	126	0	0
BSS 249	„		—	
BSS 1400-B6 85/15 ..	„		—	
***Gunmetal**				
R.C.H. 3/4% ton ..	ton		—	
(85/5/5/5)		152	0	0
(86/7/5/2)	„	162	0	0
(88/10/2/1)	„	208	0	0
(88/10/2/½)	„	216	0	0
Manganese Bronze				
BSS 1400 HTB1	„	164	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	230	0	0
Phosphor Copper				
10%	„	198	0	0
15%	„	208	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	347	6	0
Grade D Plumbers ..	„	281	9	0
Grade M	„	380	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	93	2	6
Mazak V	„	97	2	6
Kayem	„	103	2	6
Kayem II	„	109	2	6
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	9
Sheet 18 S.W.G.	„		2	11
Sheet 24 S.W.G.	„		3	2
Strip 10 S.W.G.	„		2	9
Strip 18 S.W.G.	„		2	10
Strip 24 S.W.G.	„		2	11½
Circles 22 S.W.G.	„		3	3
Circles 18 S.W.G.	„		3	2
Circles 12 S.W.G.	„		3	1
Plate as rolled	„		2	8½
Sections	„		3	2½
Wire 10 S.W.G.	„		3	0
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1½
Sheet 18 S.W.G.	„		3	4
Sheet 24 S.W.G.	„		3	11½
Strip 10 S.W.G.	„		3	1½
Strip 18 S.W.G.	„		3	3
Strip 24 S.W.G.	„		3	11
BS1477 HP30M. Plate as rolled			2	11½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	9½
Sheet 18 S.W.G.	„		4	1½
Sheet 24 S.W.G.	„		4	11½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	1½
Strip 24 S.W.G.	„		4	9
BS1477. HPC15WP. Plate heat treated ..	„		3	6½
BS1475. HG10W. Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP Tubes 1 in. o.d. 16 S.W.G.	„		5	0
BS1476. HE10WP. Sections	„		3	2
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	4½
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	200	0	0
Extruded Bar	lb.		1	7½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	137	0	0
Condenser Plate (Naval Brass)	„	147	0	0
Wire	lb.		2	1⅞
Bronze Sheet and Strip	ton		—	
Copper Tubes	lb.		1	7½
Sheet	ton	190	0	0
Strip	„	190	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	212	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	1½
Lead Pipes (London) ..	ton	115	5	0
Sheets (London)	„	113	0	0
Tellurium Lead	„		£6 extra	
Nickel Silver				
Rods	lb.		—	
Sheet and Strip 7% ..	„		3	2
Wire 10%	„		3	8½
Phosphor Bronze				
Wire	„		3	4½
Titanium				
Billet	lb.	4	10	0
Sheet	„	6	12	0
Wire	„	9	10	0
Tube	„	16	0	0
Zinc Sheets, English destinations	ton	98	0	0
Strip	„		nom.	

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 25/2/58.

	£
Aluminium	
New Cuttings	160
Old Rolled	130
Segregated Turnings	100
Brass	
Cuttings	106
Rod Ends	102
Heavy Yellow	84
Light	79
Rolled	96
Collected Scrap	82
Turnings	96
Copper	
Wire	133
Firebox, cut up	132
Heavy	127
Light	122
Cuttings	133
Turnings	116
Braziery	108

	£
Gunmetal	
Gear Wheels	138
Admiralty	138
Commercial	113
Turnings	108
Lead	
Scrap	65/10
Nickel	
Cuttings	—
Anodes	529
Phosphor Bronze	
Scrap	113
Turnings	108
Zinc	
Remelted	55
Cuttings	41
Old Zinc	29

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£143.10.0)	165
Heavy copper	(£143.10.0)	165
Light copper	(£121.17.6)	140
Heavy brass	(£91.7.6)	105
Light brass	(£65.5.0)	75
Soft lead scrap	(£56.10.0)	65
Zinc scrap	(£39.2.6)	45
Used aluminium unsorted	(£82.12.6)	95
France (francs per kilo):		
Copper	(£187.0.0)	215
Heavy copper	(£187.0.0)	215
Light brass	(£134.17.6)	155
Zinc castings	(£67.0.0)	77
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£139.5.0)	160

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£104.10.0)	180
Lead, soft, first quality	(£87.0.0)	150
Lead, battery plates	(£52.5.0)	90
Copper, first grade	(£159.10.0)	275
Copper, second grade	(£148.0.0)	255
Bronze, first quality machinery	(£165.7.6)	285
Bronze, commercial gunmetal	(£136.7.6)	235
Brass, heavy	(£110.5.0)	190
Brass, light	(£98.12.6)	170
Brass, bar turnings	(£113.2.6)	195
New zinc sheet clippings	(£58.0.0)	100
Old zinc	(£49.7.6)	85

Financial News

British Oxygen Co. Ltd.

Accounts for year to end of September, 1957, show trading profit of £5,964,085 (£5,198,464). To general reserve £750,000 (£500,000). Final dividend recommended of 6 per cent, making 10 per cent for year (same).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons, Limited, Company Registration Agents, Chancery Lane, W.C.2.

Exors. of J. H. Robinson Limited (596549), John Street, Stockport. Registered January 6, 1958. To take over business of coppersmiths and sheet metal workers carried on at Stockport by J. H. Robinson, etc. Nominal capital, £20,000 in £1 shares. Directors: J. H. Robinson and H. Robinson.

Withey and Cooper Limited (596611), Lily Street, Monsall, Manchester, 9. Registered January 6, 1958. To carry on business of machinery and metal merchants, etc. Nominal capital, £1,000 in £1 shares. Directors: L. Withey, G. Withey, Lily Withey and M. R. Withey.

Fowler and Brown Limited (596831), 42 Ashmole Street, S.W.8. Registered January 9, 1958. To carry on business of metal and alloy makers, etc. Nominal capital, £100 in 6s. 8d. shares (75 "A" ord., 75 "B" ord., 75 "D" ord. and 75 "C" ord.). Director: H. F. Fowler.

Homogenous Bondings Ltd. (596834), 23 Geoffrey Gardens, E.6. Registered January 9, 1958. To carry on business of metal bonders, etc. Nominal capital, £100 in 6s. 8d. shares (75 "A" ord., 75 "B" ord., 75 "C" ord. and 75 "D" ord.). Director: H. A. Brown.

Lodge Metals (Burnley) Limited (596976), Lodge Yard, Waterloo Road, Burnley. Registered January 13, 1958. Nominal capital, £1,000 in £1 shares. Directors: J. F. Pollard, T. Rambadt, W. Wallace and J. Wilson.

Metasonics Ltd (597067), 29 Museum Street, W.C.1. Registered January 14, 1958. To carry on business of removers of surface deposits on metal by ultrasonic and other methods, etc. Nominal capital, £100 in £1 shares. Directors to be appointed by subscribers.

Innes Metal Co. Limited (597223), 13 Westbourne Road, Fallowfield, Manchester, 14. Registered January 15, 1958. Nominal capital, £500 in £1 shares. Directors: A. Smith and J. J. Casby.

Trade Publications

Dust Problems. — Dallow Lambert and Co. Ltd., Thurmaston, Leicester.

Examples from this company's range of products for the collection and disposal of dust are described in a 12-page brochure just distributed. Included are details and illustrations of the Dustmaster and Drytex unit dust collectors, Drytube filters, wet dedusters, and the like.

Chemicals for Paints, etc.—Armour and Company Ltd., G.P.O. Box 250, Lindsey Street, Smithfield, London, E.C.1.

The chemical division of this company has just published a new booklet entitled "Catonic Chemicals for Paints, Pigments and Printing Inks." It is believed that this is the first time that a comprehensive booklet on the use of catonic chemicals for pigments and surface coatings has been published. In 18 chapters, a great variety of subjects are dealt with. The booklet will be released generally at the Oil and Colour Chemists' Association Exhibition in March, but advance copies are available upon request now.

Solder Products. — Perdeck Solder Products Limited, Abbey Mills, Waltham Abbey, Essex.

New literature has just been made available by this company. This includes a leaflet on tinning all normally solderable metals, describing methods and specification, on "Epatam 3311," code "B" solder paint, together with a technical information sheet. Other leaflets describe tinning and soldering stainless steel, "Epatam 3311" solder paint and solder paste; tinning through rust without precleaning, and soldering without special precleaning. In all cases a full description, with methods and specifications is given, together with useful information sheets.

Electroplating and Metal Finishing.—The Electro-Chemical Engineering Company Limited, Sheerwater, Woking, Surrey.

The second edition of the Efco-Udylite Review contains a number of interesting articles on metal finishing and plating developments, together with news of progress in Efco-Udylite processes. There are a number of good photographs, and news of the company's activities in various parts of the world.

Aluminium Alloy Pressure Diecastings.—Fry's Diecastings Ltd., Brierley Hill Road, Wordsley, nr. Stourbridge.

A new 28-page booklet has been issued by this company dealing with pressure die-castings in aluminium alloys. A great deal of information is given relating to methods of production, together with many photographs of actual castings produced in aluminium alloys. Complimentary copies of this useful booklet may be obtained on application to the company.

Drop and Upset Forging Technique. Head Wrightson Stampings Ltd., Brenda Road, Seaton Carew, Co. Durham.

Within the space of 28 pages is contained a great deal of information, with diagrams and illustrations of the techniques relating to drop and upset forging. The main object of this booklet is to put before the engineer-designer the basic principles of forging in order to assist him to produce a better component more economically.

THE STOCK EXCHANGE

All Round Weakness In Industrials

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 25 FEBRUARY	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	18/6	—3d.	10	10	10 16 3	19/9	18/6	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6		8½	7½	11 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	47/–	—9d.	15	15	6 7 9	50/–	47/–	72/3	47/9
1,590,000	1	Birfield Industries	50/–	—9d.	15	20N	6 0 0	53/9	50/–	70/–	48/9
3,196,667	1	Birmid Industries	56/9	—3d.	17½	17½	6 3 3	57/9	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	24/10½	—1½d.	10	8	8 0 9	26/7½	24/10½	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/7½	—4½d.	5	5	6 16 9	15/–	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/10½	+4½d.	6	6	7 2 3	17/–	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	27/6	—1/3	12½	12½	9 1 9	28/9	27/6	30/3	28/9
300,000	1	Ditto Pref. 5%	15/3		5	5	6 11 3	—		16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/–		7	7	7 7 3	—		22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	43/6	—9d.	12	12	5 10 3	44/9	41/3	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/3		6	6	6 4 9	19/3	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	39/6	—1/6	12½	12½	6 6 6	42/–	38/10½	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord ...	29/9	+9d.	10	10	6 14 6	32/3	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	20/6	—1½d.	25	25	6 2 0	20/7½	20/1½	24/6	19/3
60,484	1/–	Carr (Chas.)	2/1½		25	25	X8 4 9	2/3	2/–	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/4½	—1½d.	25	25	11 8 6	4/9	4/4½	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	16/–		10	15N	12 10 0	16/6	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/10½		6	6	7 11 3	—		17/6	16/–
250,000	2/–	Coley Metals	3/6	—1½d.	25	25	14 5 9	4/6	3/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	45/–	+2/–	22½	22½	10 0 0	51/6	43/–	92/6	49/–
1,136,233	1	Davy & United	47/6		15	12½	6 6 3	48/–	46/3	60/6	42/6
2,750,000	5/–	Delta Metal	19/7½	—6d.	*17½	*17½	4 9 3	21/4½	19/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	24/6	—1/6	15B	22½	10 4 0	26/6	24/–	38/6	25/–
500,000	1	Evered & Co.	40/6	—9d.	15	15	7 8 3	41/3	40/6	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	30/1½	—6d.	12½	14	Y7 12 0	38/7½	30/1½	59/–	38/–
1,250,000	Stk. (10/–)	General Refractories Ltd.	28/–		17½	17½	6 5 0	28/3	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	65/–		15	12	4 12 3	65/–	64/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	5/9		11½	11½	10 0 0	6/–	5/7½	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	13/6	+1½d.	20	20	7 8 3	13/6	12/10½	18/–	12/6
3,614,032	10/–	Goodlass Wall & Lead Industries ...	28/6	+3d.	18	16	6 6 3	29/9	28/3	37/3	28/9
342,195	1	Greenwood & Batley	46/10½		17½	17½	7 9 3	—		50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	11/6		*15	*30‡	6 10 6	—		16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9		7	7	7 9 3	—		22/3	18/7½
1,075,167	5/–	Heenan Group	7/1½	—6d.	10	20‡	7 0 3	7/7½	6/9	10/4½	6/9
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	36/6	—9d.	10	10	5 9 6	39/10½	36/6	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/6		5	5	6 1 3	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	138	—1	$3.75	$3.75	4 17 0	144	136½	222	130
430,000	5/–	Jenks (E. P.), Ltd.	15/3	—1½d.	27½ ϕ	27½	9 0 6	15/7½	14/6	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/–		5	5	6 13 3	—		17/–	14/6
3,987,435	1	Ditto Ord.	37/6	—1/6	10	9	5 6 9	41/3	37/6	58/9	40/–
600,000	10/–	Keith, Blackman	16/3		15	15	9 4 6	16/3	15/–	21/9	15/–
160,000	4/–	London Aluminium	3/6	—3d.	10	5	11 8 6	4/3	3/6	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord....	40/–	—9d.	12½	12½	6 5 0	41/9	40/–	54/6	41/–
400,000	1	Ditto Pref.	22/9		7½	7½	6 11 9	—		25/3	21/9
765,012	1	McKechnie Brothers Ord.	35/–		15	15	8 11 6	—		48/9	37/6
1,530,024	1	Ditto A Ord.	32/6		15	15	9 4 6	—		47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	9/–	—3d.	27½‡	25	7 12 3	9/6	9/–	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	5/9		7½	7½	7 16 6	—		6/6	5/–
13,098,855	Stk. (£1)	Metal Box	41/9	—9d.	20‡	15M	4 15 9	43/9	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	6/3		50	50	16 0 0	6/6	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	22/–	—9d.	10	10	9 1 9	22/9	22/–	25/–	21/6
80,000	5	Ditto Pref. 6%	83/6		6	6	7 3 9	—		90/6	83/6
3,064,930	Stk. (£1)	Morgan Crucible A	34/–	—6d.	10	11	5 17 9	36/6	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/3		5½	5½	6 7 6	17/3	17/–	19/3	16/–
2,200,000	Stk. (£1)	Murex	54/9	—3d.	20	20	7 6 0	57/6	54/9	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	7/1½	+1½d.	10	10	7 0 3	7/1½	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	27/–		27½D	27½	6 15 9	27/–	26/–	41/–	24/9
1,365,000	Stk. (5/–)	Serck Radiators	11/–	—4½d.	17½Z	15	5 6 0	12/–	11/–	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	43/9		16	16	7 6 6	—		57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	20/–		6½	6½	6 10 0	—		21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	48/4½	—1½d.	15	15	6 4 0	53/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	29/7½	—6d.	10	10	6 15 0	31/–	29/4½	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/6		5	5	6 9 0	15/6	14/9	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	23/–		*5	*5	6 14 3A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	72/–	—1/–	20	15	5 11 0	73/6	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	35/6	—9d.	10	18P	5 12 9	36/3	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	7/3	—3d.	25	40	6 18 0	7/9	7/2½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	15/3		27½	27½	9 0 3	15/6	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/6	—1½d.	20	17½E	14 5 9	3/9¾	3/6	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	—		12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	2/10½	—1½d.	40D	33⅓	9 5 6	3/1½	2/7½	5/–	2/?

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. H and 200% capitalized issue. M and 10% capitalized issue. Y Calculated on 11½% dividend. ||Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share or £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And proposed 100% capitalized issue. X Calculated on 17½%.